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# Worldwide Report

## NUCLEAR DEVELOPMENT AND PROLIFERATION

No. 195

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# WORLDWIDE REPORT

## NUCLEAR DEVELOPMENT AND PROLIFERATION

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## NEAR EAST/SOUTH ASIA

# ATHOLIC BHSIOPS BACK U.S. COLLEAGUES ON NUCLEAR ARMS

Brisbane THE COURIER-MAIL in English 9 May 83 p 12

[Article by Tess Livingstone]

[Text]

**AUSTRALIAN Roman Catholic bishops have applauded their American counterparts for entering the nuclear debate by producing a strong resolution calling for a halt to the testing, production and deployment of new nuclear weapons.**

"Nuclear arms are one of the most important issues that we have to face and they have tackled the question in a way that is very courageous," the Roman Catholic Archbishop of Brisbane, the Most Rev. Francis Rush said yesterday.

Neither Archbishop Rush nor Australia's senior Catholic bishop, Archbishop Edward Clancy of Sydney, said he was surprised at the extent of the American bishops' endorsement of the resolution — the 150 page document was supported by 238 votes to nine.

"They have been working on it for a very long time, for years," Archbishop Rush said.

"Every nation is morally bound to work for peace, and the heart of the question is whether the nuclear deterrent is morally defensible."

He said the issue was both a political and a moral one.

Both Archbishop Rush and Archbishop Clancy endorsed a statement which the Australian bishops published in last May.

The statement said, in part: "Christians must assume a leadership role in the work for peace.

"They must condemn the arms race unreservedly for it is a danger, an injustice, a mistake, a sin and a folly. Indeed, the arms race represents a choice of death rather than life.

"In saying all of this, we do not deny for one moment the right of every country to defend itself."

Archbishop Clancy said the American bishops' support of such a strong anti-nuclear document could be seen by Russia as a sign of weakness. Archbishop Rush said there was no possibility of churches within the Soviet Union being able to lobby their government in the same way.

But Archbishop Clancy said that people who said that it was futile for Western bishops to call for a halt to nuclear weapons when their voice would make little impact in Russia were taking too simplistic a view of a complex issue.

Archbishop Clancy said he had no doubt the US bishops would have been in touch with the Holy See, and would not have acted against the instructions of the Pope.

Bishop Cuskelly (Auxiliary, Brisbane) said he admired the bishops for tackling the issue and stirring up serious debate across America.

CSO: 5100/7533

EUROPE WARY OF GOVERNMENT URANIUM POLICY; SALES TO FRANCE

EEC Warning

Melbourne THE AGE in English 9 May 83 p 7

[Text]

**BRUSSELS, 8 May. — The Australian Labor Government has been given a clear warning that its present policies on uranium could create difficulties in commercial relationships between Australia and the European Economic Community.**

According to senior EEC sources, the Australian Foreign Affairs Minister, Mr Hayden, was given a "friendly presentation of certain realities" about his Government's policy of not exporting uranium to France while it continued nuclear testing in the Pacific.

One such reality was that although Australia's overall exports to the EEC were picking up, there were not many items Australia supplied that could not be got elsewhere.

Mr Hayden received Europe's views in talks on Friday with a vice-president of the European Community and its Commissioner for Energy, Viscount Etienne Davignon, the sources said.

Viscount Davignon pointed out that it would be a matter of great concern not just for France but the whole Community if there was to be a prohibition on Australian uranium exports to France. Australia also has uranium contracts with Europe's atomic energy agency, Euratom.

Termination of sales would reflect on Australia's reliability as a supplier and the continuity of supplies such as coal, Mr Hayden was told.

It would create difficulties for the community in terms of its commercial relations with Australia if contractual responsibilities were not going to be honored.

The sources said that these observations were made in a friendly fashion and were not a threat, it was a clear warning to the Labor Government that its present policies on uranium could present problems. — AAP

## Hayden on Exports to French

Canberra THE AUSTRALIAN in English 19 May 83 p 1

[Article by Errol Simper]

[Text] Australia would continue to export uranium to France at least until a review of safeguard arrangements was completed, the Minister for Foreign Affairs, Mr Hayden, pledged yesterday.

Speaking in Sydney on his return from a two-week visit to Europe, Mr Hayden said: "We have a review of bilateral safeguards arrangements under way, and until that is completed--and it will take a while--existing contracts will be discharged."

Mr Hayden said that implementation of the official ALP policy--not to export uranium to France as long as it continues weapons-testing in the South Pacific Ocean--could worsen Australia's already-sensitive trade relationship with the entire European Economic Community.

"At the EEC in Brussels, it was made fairly plain to me that a termination of exports of uranium, provided for under contractual arrangements, would present very serious problems for the community generally, and not just for France," he said.

Mr Hayden said the problems would be "in relation to whether Australia was a reliable supplier of commodities--and that would include things like coal."

### Predictions

On Australia's long-running battle over the community's Common Agricultural Policy ( allows the EEC to undercut Australian prices on world markets with heavily-subsidised produce), Mr Hayden said there were "vast political problems" for the EEC to overcome.

Progress toward reform of the policy was likely to be "slow and difficult" but there was consolation in that the EEC itself desired to change a policy which accounted for two-thirds of the community's budget.

On general economic matters, Mr Hayden warned that Australians could "tear this country apart" if they didn't work together to overcome what he called "these tough times."

Mr Hayden said: "I have to say that, in the last 24 hours, predictions from America that interest rates there have probably bottomed--and might even go up again--are very disturbing.

"The major thrust of discussions with European representatives of the OECD are that unless North American interest rates come down, then any American recovery is not going to be fully transmitted to Europe and to the rest of the world.

"The reason simply, is that high American interest rates are dragging money out of Europe."

"Now, for Australia, that's not good news," he said. "We're largely a commodity producer and seller on world markets, mainly mineral markets. Which means we need a world recovery to pick us up.

"It means that unless American interest rates come down, we're looking at a situation over the next year or so where any economic activity is going to be very strained.

"We can do a bit locally--and we've got to. But it's going to be limited. What we do is going to have to be done together. We're going to have to pull together. The prices and incomes policy of the Government has to be supported by all parts of the community."

CSO: 5100/7532

# OPPOSITION CONTINUES TO FRENCH NUCLEAR TESTS IN PACIFIC

## Hayden Talks in Paris

Brisbane THE COURIER-MAIL in English 13 May 83 p 8

[Text]

PARIS (AAP).— The Australian Government is planning to mobilise support for a nuclear-free zone in the south-west Pacific, and to take leadership in lifting the disarmament issue as an international debating point.

The Foreign Minister, Mr Hayden, foreshadowed both of these initiatives after talks with his French counterpart, Mr Claude Cheyson, and the French Secretary of State for Overseas Departments and Territories, Mr Georges Lemoine.

Mr Hayden also discounted statements by the New Zealand Prime Minister, Mr Muldoon, that an end to testing was in sight. Mr Muldoon had talks with the French President, Mr Mitterrand, earlier this week.

Mr Hayden said: "We didn't get that message at all."

Mr Cheyson said that with improved scientific methods it would be the hope of the French eventually to test trigger devices in a laboratory situation, but that they were still a long way removed from that.

Mr Hayden said: "I think therefore that a prospect of testing in the south-west Pacific, given the other statement the French have made about their firm commitment to an independent nuclear deterrent, means very simply that moving the testing away from the south-west Pacific at this point is a long way off."

## More on Paris Meeting

Canberra THE AUSTRALIAN in English 13 May 83 p 4

[Article by Philip Beard]

[Text]

AUSTRALIA is to launch a big diplomatic effort to secure a nuclear-free zone in the south-west Pacific following yet another strong rebuff for Canberra on its objections to French atomic testing at Mururoa Atoll.

At a meeting yesterday the Minister for Foreign Affairs, Mr Hayden, was told by the French Foreign Minister, Mr Claude Cheysson, that the devices currently being tested were nuclear triggers, not warheads, and were clean.

Mr Cheysson said France would not stop the tests.

Mr Hayden said it did not matter what devices were being tested, "the socialist Government in Australia is against all tests and stockpiling of nuclear weapons".

He said he would lobby for the zone before the 13-nation South Pacific Forum met in Canberra in August.

Nuclear-powered and nuclear armed vessels would be able to pass through such a nuclear free zone.

Work was under way within the Foreign Affairs Department to secure the support of the Governments of Fiji, the Solomon Islands, Nauru, Tonga, Papua New Guinea, Cook Islands, Kiribati, New Zealand, Niue, Tuvalu, Western Samoa and Vanuatu.

Earlier this week, at a meeting with the New Zealand Prime Minister, Mr Muldoon, President Mitterand had hinted that the French were optimistic about shortly being able to test the nuclear trigger devices away from the South Pacific.

Mr Hayden said the French had given him no indication about when the laboratory-type testing would start.

## Northern Territory View

Sydney THE SYDNEY MORNING HERALD in English 11 May 83 p 9

[Text]

Australia could reduce nuclear testing in the Pacific by selling more uranium to the French, the Northern Territory's Chief Minister, Mr Everingham, said in Sydney yesterday.

"We can wave our impotent diplomatic fists at the French endlessly over their tests on the Mururoa Atoll with little effect at present — but if we were their major and most stable supplier of uranium, we could exert considerable leverage, not only on testing, but their Pacific policy generally," he said.

Speaking at a Sydney Chamber of Commerce luncheon, Mr Everingham said the French Government would be willing to accept restrictions governing the use of uranium in return for contracts guaranteeing stable supplies.

"The French are now looking for stable suppliers to replace uranium imports from former colonies which have proven unreliable," Mr Everingham said, and predicted that uranium demand would outstrip supply by 1989 — giving Australia the opportunity to influence the world.

"It is an opportunity which is our responsibility to take up. Our uranium industry has the capacity to give us weight out of all proportion to our population and economy, in world affairs."

## Issue of U.S. A-Ship Visits

Canberra THE AUSTRALIAN in English 18 May 83 p 6

[Text] The Prime Minister, Mr Hawke, made it clear the Government would not seek to ban nuclear powered or armed American warships from the Pacific, or stop them using Australian ports.

At the same time, he said, Australia shared opposition with other Pacific nations to the testing and storing of nuclear weapons, or the dumping of nuclear waste in the Pacific.

Dr Doug Everingham (Lab, Qld) asked Mr Hawke whether he could confirm statements by the Minister for Foreign Affiars, Mr Hayden, that Australia supported a nuclear-freeze zone in the Pacific, but would support activities by US nuclear powered warships.

Dr Everingham asked whether the two were compatible.

Mr Hawke said the countries of the South Pacific, including Australia, strongly opposed the testing and storage of nuclear weapons, and the dumping of waste in the region.

"At the same time as we have that view, we are concerned to do nothing to endanger our alliance relationship with the United States," he said.

Australia did not wish to impede the passage of US nuclear powered ships or port calls.

Similarly, it did not wish to impede US aircraft.

He said Mr Hayden had discussed the nuclear-free zone with the US Secretary of State, Mr Shultz, in Paris last Sunday.

"We are still continuing to have discussions on these issues with other Pacific partners," Mr Hawke said.

He said it would be an important item of discussion at the South Pacific Forum meeting later this year.

CSO: 5100/7532

GOVERNMENT MOVES TO CUT U-ENRICHMENT, NUCLEAR RESEARCH

Canberra THE WEEKEND AUSTRALIAN in English 14-15 May 83 p 6

[Article by Jane Ford]

[Text]

THE Federal Government has asked the Australian Atomic Energy Commission to wind down its uranium enrichment program in the first big move to curtail nuclear research and stop development of a uranium reprocessing industry in this country.

The move is in line with the Government's election promises and could lead to an end to funding for other nuclear research projects at universities and research institutions.

It also puts in doubt the future of two important studies – one on enrichment by the Uranium Enrichment Group of Australia; the other on uranium conversions by an industrial consortium made up of Broken Hill Associated Smelters, British Nuclear Fuels Ltd and Roxby Management Services Ltd. These studies are both now on ice until the Government decides what action to take.

Uranium enrichment is the commission's main research project, involving almost a quarter of its 300 or so research staff, and by last June the work had been supported with a total of $2 million worth of national energy research, development and demonstration funds.

The Government also says it is planning to go ahead with its election promise to split the commission into three separate authorities.

One will be an independent regulatory authority responsible for nuclear-related environmental protection, health, safety, security, safeguards and other non-proliferation activities.

## Novel

A second will be a government corporation to carry out the present commercial activities of the commission, such as the production and marketing of radio-isotopes, and the third will be a nuclear science authority to perform the commission's other nuclear research work.

A spokesman for the Minister for Resources and Energy, Senator Walsh, said there was no urgency about any of the moves, although the minister's office had told the commission it would like to see the enrichment work wound down in the not-too-distant future.

Splitting the commission into three separate bodies could wait longer and would need further discussion and consultation.

The split will be the second in two years for the commission, which lost a third of its staff in 1981 after a Razor Gang decision to transfer all non-nuclear research to the CSIRO

Enrichment work has been the Atomic Energy Commission's main research project for some years and has involved the development of centrifuge technology for uranium enrichment, along with assessment studies and a laboratory program to improve the design of individual centrifuge machines.

Testing of the individual behavior of centrifuges and investigation of other more novel enrichment processes, such as laser technology and high-resolution spectroscopy of the uranium compounds, has also been carried out.

The decision to close the project has caused consternation among some scientists at the commission, but it is believed there will be no retrenchments and all researchers will be moved to other porjects such as radio-isotope works, environmental projects or Synroc (the new method of nuclear waste disposal developed by Professor Ted Ringwood of the Australian National University).

## Completed

Synroc is one project the Government says it is definitely backing, but ironically, Professor Ringwood made a strong plea last month for the continuation of uranium mining and the development of a reprocessing industry in this country.

He told the South Australian Chamber of Mines in Adelaide that stopping the supply of Australian uranium to the world market would have no influence on the commitment of many foreign countries to nuclear power.

He said that by developing a re-processing industry in this country to extract plutonium from spent fuel from foreign reactors, Australia could reduce the risk of proliferation of nuclear weapons.

The Uranium Enrichment Group, which includes BHP, CSR and Western Mining (Peko Wallsend pulled out last year), completed its main study last year. This recommended that Urenco-Centec centrifuge technology should be adopted and further marketing studies carried out.

The previous government accepted these recommendations and asked the group to report back to it after a detailed market survey based on the Urenco-Centec technolgy.

The group's secretary, Mr Nick Brieger, says the organisation has now suspended the survey and is awaiting developments from the Government.

The $500,000 conversion study, which in turn depends on the enrichment study (because a conversion plant would supply uranium hexafluoride for the enrichment plant), has been completed.

CSO: 5100/7533

URANIUM MINERS IN WEST AWAIT GOVERNMENT POLICY CLARIFICATION

Perth THE WEST AUSTRALIAN in English 14 May 83 p 23

[Article by Peter Alford]

[Text]

FOUR Federal ministers recently shouldered one of the most delicate tasks to confront the new Government—translating the Labor Party's uranium platform into firm policy.

The guidelines they establish will fix the course of uranium mining during Labor's term of office and inevitably trigger another outburst of squabbling about Australia's place in the nuclear industry.

Whichever way the Federal Government jumps, Western Australia will be immediately affected because of the Yeelirrie project, 650km north-east of Perth.

As Labor policy now stands, the $350 million project being developed by Western Mining Corporation is in deep trouble on two counts.

But the policy cobbled together last year is complicated and, in places, contradictory. Pragmatic interpretation may allow Yeelirrie to scrape through.

## New

The policy makes an important distinction between existing mines and "new mines" and states that a Labor Government is committed to "preventing any new mines from being developed during our period in office."

WMC can argue that Yeelirrie has already produced yellowcake from its pilot processing plant near Kalgoorlie.

Another possible let-out is the clause that allows uranium to be produced in association with other minerals.

The Yeelirrie plan envisages production of 2000 tonnes of vanadium annually alongside 2500 tonnes of yellowcake.

But there is one plank in the uranium platform on which the Government will not budge—sales to France are prohibited while it continues to test nuclear weapons in the South Pacific.

## Election

Up to the Federal election, WMC had been negotiating with the French Government-owned Commissariat a l'Energie Atomique for it to become a big yellowcake customer and an equity partner in the project.

Those discussions and talks with other potential customers ceased when the new Government withdrew negotiating licences from all the companies developing uranium projects.

WMC's executive director, Mr Hugh Morgan, said this week that his company would not reapply for a licence until the ministerial review was finished.

"We await that review with interest and hopefully believe that the Government would find the project worthy," he said.

France has the biggest nuclear power programme in the Western world and finding other customers to fill its shoes

may present WMC with a larger problem than getting the project approved.

## Low profile

The State Government has so far taken a low profile on the Yeelirrie question and is clearly waiting for a Federal lead.

Three other uranium deposits in WA are under some form of development.

The furtherest advanced is the Lake Way project, a joint venture between CSR Ltd and Vam Ltd, near Wiluna.

Lake Way had Federal approval from the previous administration but has also had its negotiating licence withdrawn pending the ministerial review.

Production was to start in 1985 or 1986 with an annual output of 500 tonnes of yellowcake.

The partners canvassed for customers in the U.S., Japan and Korea last year but were unable to get orders.

One venture of particular interest to the Premier, Mr Burke, is PNC Exploration (Australia) Pty Ltd's project in the Officer Basin, about 200km east of Kalgoorlie.

Mr Burke, who is visiting Japan, was startled last week by a front-page report in a mass-circulation newspaper that the subsidiary of Japan's Power Reaction and Nuclear Fuel Development Corporation had made a big and rich find in the basin.

PNC Exploration's managing director, Dr S. Okada, confirmed this week that it was planned to ship several tonnes of ore to Japan later this year for assessment.

But a drilling programme on the company's tenements is likely to extend for several more years before the corporation will consider a feasibility study.

- At Manyingee Hill, about 80km south of Onslow, the French company Minatome is continuing to assess the possibility of extracting uranium by a leaching process.

## Pumping

This involves pumping an acid solution into the ore body. The acid dissolves the uranium and is pumped out.

Those drawing up the uranium guidelines, assisted by senior departmental officers, are the Deputy Prime Minister, Mr Bowen, the Minister for Resources and Energy, Senator Walsh, the Environment Minister, Mr Cohen, and the Aboriginal Affairs Minister, Mr Holding.

The review is expected to be completed within three months.

CSO: 5100/7533

URANIUM EXPORT ISSUE SHARPENS AS ROK TURNS TO CANADA

Canberra THE WEEKEND AUSTRALIAN in English 14-15 May 83 p 23

[Article by Nicholas Rothwell]

[Text]

THE dissolution of Australia's uranium export industry continued yesterday with the announcement by a major firm in South Korea, one of the most important potential customers for locally produced yellowcake, that it would turn to Canada for a world-scale supply contract.

The giant Daewoo Co, one of the major Korean conglomerates, disclosed yesterday in New York that it would join with the Canadian subsidiary of Germany's Urangesellschaft MBH in a major uranium exploration and development venture in Canada's north-west territories.

The Korean decision is certain to influence the actions of potential uranium buyers throughout South-East Asia, including nations such as Taiwan and the Philippines.

Daewoo Corp will now throw its resources into the Baker Lake uranium project, located north of Manitoba and north-west of Hudson Bay, where the German partner has been conducting extensive exploration since 1974 and proved up more than 15.5 million kgs of uranium ore.

Korea had been eagerly eyed by Australian producers expecting to develop giant mines in the Northern Territory, such as Jabiluka, for the east Asian export market.

The decision by Daewoo to opt for Canada, the chief rival low-cost potential producer, comes during a bad week for the Australian uranium industry in general.

In the past few days, the intention of the new Labor Government to apply rigorously its policy of permitting development of new uranium mine projects only in association with other minerals — a rule framed to let Roxby Downs in South Australia slip through — has been underlined, and Northern Territory Government officials have warned of the adverse effects on the regional economy of a halt to uranium development in the Top End.

A restructuring of the Australian Atomic Energy Commission, to be announced soon, will also force a scaling back of work on commercial applications of nuclear energy such as enrichment — a field where Australian scientists must be pre-eminent if locally-based enrichment, as envisaged by the Uranium Enrichment Group of Australia consortium, is to be feasible.

The decision by the Korean company to look to Canada, which is aggressively positioning itself as the major free world producer of the nuclear fuel, effectively signposts the doubts of Pacific Rim States about Australia's reliability as an energy supplier.

The decision is certain to be closely noted in the major Northern Territory uranium buying nation, Japan.

Daewoo and Urangesellschaft — itself a major prospector in the Top End in recent years — expect to produce 2000 metric tonnes a year from Baker Lake beginning in 1990.

The project is of great national importance to the Koreans since Daewoo's share of the production will go to the Korea electric power company on a long-term supply contract basis.

Like many of the newly industrialising nations of South-East Asia, Korea has scant domestic oil reserves and seeks the energy security ultimately promised by the nuclear fuel cycle — at the end of last year, Korea was generating 1770 megawatts of electricity by nuclear power, but that capacity will be boosted to almost 9500 mw by 1991.

Korea now receives its uranium under contracts from the US, Canada and Australia. Daewoo is the first company in Korea to participate in uranium development — previous involvement was restricted to government bodies.

Daewoo is now engaged in several other resource development projects involving the provision of energy supplies for Korea — two were signed last year.

CSO: 5100/7533

NEW BOOK DISCUSSES EFFECTS OF NUCLEAR WAR ON PERTH, WA

Perth THE WEST AUSTRALIAN in English 13 May 83 p 9

[Article by David Britton]

[Text]

THE BUTTON is pressed. A nuclear missile plunges to the heart of one of Europe's major cities. Others follow. Hundreds, perhaps thousands.

Some 13,000km away, Perth waits. Its share must come.

When it does, the effects are devastating. Four warheads, three of 300 kilotons and one of 100 kilotons, are dropped on the Perth metropolitan area. Single 300-kiloton warheads are groundburst on North-West Cape and Cockburn Sound. Another falls on Pearce air base.

To complete the destruction, a one-megaton bomb is airburst over the North-West Shelf gas field.

This scenario, prepared by the Swedish Academy of Science, is reported in "First and Final War" a harrowing account, published yesterday, of the effects of nuclear war on Perth. The book is edited by UWA physicist Dr David Blair and issued through the UWA's University Extension.

"First and Final War" leaves little doubt that Perth is a nuclear target and describes in some detail what would happen during and after an attack.

In an all-out war, it says, "we could expect bombs on Cockburn Sound, Fremantle and Perth.

"This isn't, however, the only danger. Another danger is that in a confrontation the superpowers may choose to demonstrate that they mean business. They will choose a target of real significance but one which will be unlikely to provoke all-out retaliation.

"Such a target is best if isolated (to localise the effects) and a southern hemisphere target is a good choice —say Auckland, Capetown or Perth." And when the bombs do fall, how wide will be the effects? Who will be safe? Dr Blair's book paints this picture of the moments after the blast:

"Around Perth the searing flash simultaneously ignites fires from the coastal plain to the slopes of the Darling Range. House furnishings, grass and living trees burst instantly into flame.

"At 1200 kilometres per hour a blast wave spreads out from the centres of the explosions, fanning the fires and flattening all the buildings.

"In 20 seconds it travels about six kilometres, and is sufficiently weakened that instead of smashing all in its path, it causes lesser damage: Windows are broken, trees fall, walls and fences are blown over, and roofs are blown off. Fire damage extends to between 12 and 16 kilometres.

"Blast damage extends to between six and 12 kilometres. Lethal radiation doses are delivered to a mere five-kilometre circle, where the blast and heat cause total destruction.

"A vast plume of highly radioactive material is carried aloft in the mushroom cloud. Depending on the winds and weather, this may be deposited

within a few hours and up to 24 hours of the blast as a rain of soft ashes, spread over thousands of square kilometres. In our scenario a 25 kilometre per hour westerly wind blows the fallout as a plume spreading inland as far as York.

"Clearly, most of Perth would be devastated. Only a fraction of the population would survive the initial effects and fewer would survive the fall out.

And on the treatment of survivors, the book comments:

"One-megaton explosions over Perth, Fremantle and Cockburn Sound would effectively and immediately destroy all the major and most minor hospitals. The units specialising in the care of burns cases at Royal Perth and Princess Margaret Hospitals would definitely be gone. There are only a total of 18 beds in these burns units anyway.

"There would be few doctors and nurses left to tend the injured and sick. Even if each surviving doctor spent only 10 minutes on diagnosis and treatment of each patient, it would be many days before every injured person was seen for the first time.

"There would be no X-rays, laboratory assistance, diagnostic aids, medical supplies, drugs, plasma or blood. Help from 'outside' would be extremely unlikely due to disruption of transport and unwillingness of people to expose themselves to fallout radiation.

"Many of the injured who might have survived with adequate medical care will die, and many other injured people will need to fend for themselves without medical aid. Survivors may envy the dead."

Dr Blair admits to being partly inspired by "the collective guilt of physicists" for introducing nuclear fission, but denies that his book is propaganda. He has set out to educate the public . . .

The facts, he says, speak for themselves. He is particularly keen for the book to be read by high school students.

The danger to WA is real, he argues: "I think the threat to WA is possibly greater than the threat to, say, Washington.

"One Soviet bomb on Perth would have a very large chance of not bringing a reprisal; but bombing Washington would certainly lead to a reprisal.

"If the Russians bombed Perth, do you think the U.S. would drop a bomb on Moscow? I don't think so."

Dr Blair makes the point that many people came to WA precisely to escape the nuclear threat, but now find it catching up with them.

Perhaps those people will find some solace in the full picture from which the scenario at the start of this article was taken.

According to the Swedish Academy, the bombs falling on WA would be among 33 megatons destined for Australia. Altogether 173 megatons would be exploded in the southern hemisphere—compared with more than 5500 megatons in the northern hemisphere.

• *"First and Final War" is available from the University Bookshop or University Extension, price $5 including postage.*

CSO: 5100/7533

V-1 NUCLEAR POWER PLANT OPERATIONS EVALUATED

Prague SVET HOSPODARSTVI in Czech 24 Feb 83 p 2

[Article by Eng M. Cibula, CSc, State Planning Commission: "Evaluation of the Operation of the V-1 Power Plant"]

[Text] In December 1982 the concluding technical-economic evaluation of the construction and operating results of the V-1 nuclear power station in Jaslovske Bohunuce (2 x 440 MW) was held; this is the first of a series of Czechoslovak nuclear power plants with VVER 440 reactors. During the concluding evaluation, the first Czechoslovak power unit with a VVER 440 reactor had been in operation for 4 years and the second for nearly 3 years.

From the beginning of operation to the end of 1982, the V-1 power station produced a total of 17.7 billion kWh and, by using the economically most accessible nuclear fuel, it saved about 19 million tons of brown coal at power production grade. As a result of the current high ratio of annual extraction to usable geological reserves of domestic coal, consumption cannot be expanded further, thus we are justified in evaluating the contribution of nuclear fuel in relation to imported energy resources. In this case if we find that operation of the two VVER 440 units at the V-1 station decreases demand for imported fuel in the national economy by 2 billion cubic meters of natural gas or 1.6 million tons of heating oil daily. In addition, in view of the high energy concentration of nuclear fuel, its utilization causes practically no increase in the demand for transport. Another benefit is that the V-1 power station and others are located in areas which are short of energy, which makes it unnecessary to transmit the energy over great distances, with attendant losses, as is the case with coal-fired power stations, whose construction is concentrated in coal basins as a result of fuel transport requirements. In contrast to fossil-fired power stations, nuclear power stations do not pollute the environment by emissions or in any other way. It has been shown that the actual radioactivity of gases and aerosol emitted by the cooling towers of the V-1 power stations are actually several orders of magnitude below the permissible levels. Measurements of its effects on the surroundings have shown unambiguously that operation of the power station has not increased the radioactivity in the air and soil to the national background level. The operating sets have also been shown to be of high quality and reliability.

The construction of the V-1 power station began with excavation in 1973. The duration of construction of the individual units was about 6 years, which is comparable with top results achieved in the construction of similar units abroad. The power production startup of unit 1 was begun on 7 December 1978, and that of unit 2 on 22 March 1980. Unit 1 achieved full electrical output after 4.5 months, and unit 2 after 2 months. Even in the first years of operation, the V-1 station operated with a much higher net power utilization and available power rate than in our conventional power stations. Rated values were also exceeded for several other quality indicators, which is also true of the high energy efficiency and low in-house energy consumption. In operation, the units showed fewer of the disruptions typical of initial operation of such demanding technical undertakings. The results confirm the high quality of the installed equipment, the installation and construction work, and the control and safety systems of the power station.

The construction of the V-1 power station required a considerable concentration of construction and installation capacities. The peak worker complement on site was achieved in 1977, with more than 2,400 persons. The construction schedule called for a high proportion of coordinated construction and installation work. Hydrostav, the general contractor for construction, used progressive processes for laying the foundations of the installations, production of heavy concrete, special timbering, and prefabrication, which were also used in the construction of later nuclear power stations. The work included 15 million cubic meters of excavation, emplacement of 250,000 cubic meters of concrete, and the use of 460,000 square meters of planking, 12,200 tons of reinforcing rod, and 8,800 tons of steel structural members. Skoda Plzen, the general contractor for equipment, not only was responsible for the key Czechoslovak equipment deliveries, but also conducted set assembly and installation work along with other Czechoslovak mechanical engineering enterprises, under the general installation oversight of Soviet specialists. The most demanding nuclear equipment installed was the pressure vessel (weighing 205 tons, 11.8 meters tall and with a maximum diameter of 4.27 meters), the upper reactor section (11.7 meters high and weighing 114 tons), the 6 steam generators (11.6 meters long, weighing 145 tons), and the volume compensator, the circulating pump and the stainless steel primary circuit piping (with a diameter of 500 mm).

Even during the construction of the V-1 station, heightened attention was devoted to reception and preoperation testing of materials and equipment, particularly those which were important for nuclear safety. Many research organizations were involved in this work, especially the Research Institute of Nuclear Power Stations, and oversight organs. The objective of this testing was to check the quality of production and installation of equipment which assured integrity of the primary circuit, and to establish the initial condition of the material for periodic in-service tests. To assure a coordinated approach in the finishing and startup work at the V-1 station, an interdepartmental group, in which Soviet specialists also participated, was organized.

Nonradioactive tests were carried out during startup work, including hydraulic and pressure tests, inspections and hot tests. The radioactive tests included physical startup of the reactor, power production startup, and 72-hour comprehensive testing of the units. The startup work on the primary circuit of the V-1 station was conducted by the operating personnel of the Atomove elektrarny k.p. /Nuclear Power Stations Concern/ Jaslovske Bonunice, with the participation of Soviet experts. The startup work on the secondary circuit, electrical equipment and other systems designed and delivered by Czechoslovak enterprises was carried out by the Skoda Plzen k.p. /concern/. The physical and power production startup showed that the characteristics of the V-1's technical systems were in accordance with design requirements, including self-regulating properties, transient modes and the like. Unit 1 was put into test operation after 72 hours' trial operation, and it reached the rated characteristics 115 days after the beginning of power production startup. In the case of unit 2, the use of knowledge already obtained shortened the period by more than 40 days. The experience of the operating and maintenance personnel made it possible to produce much more energy in the V-2 station during 1980-1982 than had been planned for the runup period.

The V-1 power station in Jaslovske Bohunice is one of the most technically complex undertakings in the entire history of our industry. The first delivery of heat from the nuclear power station outside of its premises will be achieved in a few years by means of a heat distribution system from the nuclear power stations at Jaslovske Bonunice to Trnava. The possibility of using waste heat for hothouses and for the needs of the food supply industry is also being tested in this area.

8480
CSO: 5100/3019

## BRIEFS

CHILEAN-ARGENTINE NUCLEAR COOPERATION--Santiago, 10 Jun (EFE)--Today Lieutenant General Herman Brady, president of the Chilean National Atomic Energy Commission, pointed out that the relations for nuclear cooperation between Chile and Argentina are smooth. General Brady recently returned from Cordoba, Argentina, where he attended the inauguration of the Rio Tercero dam in this city at the special invitation of Vice Admiral Carlos Castro Madero, president of the Argentine National Atomic Energy Commission. General Brady pointed out that Argentina has "quite a developed infrastructure and a high standard of training, but it has no intention of building nuclear devices and it uses the highly advanced technology it has for peaceful purposes only." During his stay in Argentina General Brady attended a meeting with all the presidents of Latin American nuclear commissions, with whom he discussed the problems of nuclear development. [Text] [PY110239 Madrid EFE in Spanish 1859 GMT 10 Jun 83]

CSO: 5100/2075

EMBALSE TERMED STEP CLOSER TO NUCLEAR SELF-SUFFICIENCY

Buenos Aires MERCADO in Spanish 19 May 83 pp 29-30, 39-42

[Text] From the viewpoint of Argentina's energy development, the addition of the Embalse Nuclear Power Plant to the power system means practically tripling the generating capacity of nuclear power in our country. This vast undertaking, which will contribute 600,000 KW to the national power system, has the highest power electricity generating unit in Argentina.

To get a more precise idea of what this means, we should realize that the highest power equipment in the Costanera Norte thermal power plant is 350,000 KW, or that the El Chocon turbines provide 200,000 KW each, and Salto Grande, 270,000 KW. For this reason, the inauguration of Argentina's second nuclear power plant is a major step forward in the development of our local industry and engineering capability, because it helps to consolidate a process which, begun 3 decades ago, is moving toward our national nuclear self-sufficiency.

Developments in this field are part of a policy based on the growing and sustained development of the participation of our national industry. Therefore, the technological level achieved in the nation, combined with the continuity of a plan to build a series of power plants up to the year 2000, has made it possible to develop one of the most important nuclear industries in the developing countries. This is an interesting case, perhaps unique in Argentina, of a combination of the initiative and efforts of three fundamental elements of any basic national investment project: the state, foreign capital, and Argentine private companies.

For both Atucha I and Embalse, the prior feasibility and site studies were done in Argentina, and the evaluation of the bids was an effort that involved the services of over 100 professionals. But it was in the actual planning and construction of the plant that the results showed the most significant advance.

In a typical power plant, investments are distributed as follows: 8 percent for engineering, 15 percent for civil engineering and construction, 17 percent for assembly and installation, and 60 percent for electromechanical supplies.

In Atucha I, which began operating in 1974, Argentina's participation in the engineering was practically nonexistent, but it handled 90 percent of the civil engineering and construction, 50 percent of the assembly and installation, and 13 percent of the electromechanical supplies. A decade later in Embalse, our local industry handled 13 percent of the engineering, 100 percent of the civil engineering and construction, 95 percent of the assembly and installation, and 33 percent of the electromechanical supplies.

Tentative Plan for Start of Operations

| Date | Power Plant | Location | Installed Power* | System |
|---|---|---|---|---|
| 1989 | Atucha II | Buenos Aires | 738,000 | KWU |
| 1992 | Cuyo | to be determined | 644,000 | to be determined |
| 1995 | Noroeste | " | 644,000 | " |
| 1997 | to be determined | " | 644,000 | " |

* In kilowatts

Atucha, with a power of 370,000 KW, has been operating in Buenos Aires since 1974. Embalse, with a power of 600 MW, began to operate 2 weeks ago.

In speaking of the local involvement in the construction of this nuclear plant, the chairman of the CNEA [National Atomic Energy Commission], Vice Admiral Carlos Castro Madero, explained to MERCADO that in order to make the maximum use of the investment in this project, the CNEA took on the role of main subcontractor for the construction of the nuclear part of the plant. This is certainly not a typical situation in the execution of such contracts elsewhere in the world. This helped, added Castro Madero, to stimulate the development of national service enterprises, to anticipate the training of human resources, to accelerate the pace of construction, and to obtain a more efficient use of the resources available. For the same reason, he added, the CNEA handled the jobs of assembly and installation of some critical

reactor systems, such as the calender, the fuel ducts, reactivity mechanisms, and the fuel transfer system.

The plant, which was just recently opened, is located on the southern bank of the Embalse de Rio Tercero. It was built by a consortium composed of the following firms: Energy of Canada Limited, and Italimpianti Societa Italiana Impianti. The Canadian firm was responsible for the nuclear section, and the Italian firm for the remainder of the facility, including the turbogenerator. The feasibility studies for the plant's construction were begun in 1967, at the request of the province of Cordoba. In 1971 an invitation for bids was issued. By mid-1972 eight bids had been received, prepared by six firms from five different countries.

The bids considered the options of both natural uranium and enriched uranium. The evaluation of each proposal led to the final decision to repeat the choice of natural uranium and heavy water, which had earlier been used for Atucha I. The contract was then awarded to the Italian-Canadian consortium, and was signed on 20 December 1973, with work at the site beginning on 7 May 1974. In February 1977 the electromechanical work on the plant began, including the assembly and installation of the reactor's calender.

Another key point in this contract was the CNEA's decision to assume the role of main subcontractor for the construction of the nuclear section, working under the direction of the Canadian firm. As Castro Madero explained, this facilitated the advance of the project, and also helped to increase the transfer of Canadian knowhow. But the magnitude and complexity of the project are reflected in the technical milestones passed in 1980. During that year the proce[illegible]s computer was installed, the pumping station and reactivi[illegible]echanisms were completed, the instrumentation of the nucle[illegible]a was begun, the water treatment plant began to function, [illegible] installation of the turbogenerator was completed.

Then in 1982, 2 years later, the first synchronization was made to the 132-KW network; in December of that year, the filling of the reactor with heavy water began. And during that same month, the manual loading of the 4,560 fuel elements making up the core was completed in record time. Then on 25 April 1983, 10 years after work on the project first began, the plant was connected to the national power system, and began supplying electricity generated from nuclear steam.

In order to get a clearer perception of the true dimensions of this complex and of the national involvement in its development, we can point out that the civil engineering and construction work required the movement of 700,000 cubic meters of soil, of 80,000 cubic meters of concrete, and 9,000 tons of structural iron. For pouring the concrete for the reactor building, whose wall is 1,100 cm thick, a metal traveling form with a height of 42 meters was used. And that isn't all!

The project also required the assembly and installation of 30,000 meters of pipes; 55,000 meters of tubes; 160,000 meters of control wires; and 82,000 meters of power cables. An additional problem, resolved by Argentine industry, was how to move large components, such as the calender and alternator stator, which weigh 240 and 304 tons, respectively, from Buenos Aires to Cordoba. This called for the construction of a special 180-wheel truck and a modular surface covering system. Completion of the Embalse power plant called for the efforts of skilled personnel, of workers, technicians, and professionals. The total number of personnel working on the job during peak times came to 3,700 people.

Why was Canadian technology chosen? That decision, said Castro Madero, was based on the feeling that a modular reactor system like the 600-MW Candu was the most suitable. This system had already proved itself in Canada. It was decided that the use of this type of system would be better than building a plant with two reactors each of 300-MW, as was proposed by Germany.

Furthermore, added the top CNEA official, it was realized that the high level of the Canadian natural uranium and heavy water reactors technology recognizes an objective of self-sufficiency which is similar to the objective being pursued by the Argentine nuclear plan. This factor carried a good deal of weight in the selection of the supplier. The main features of this system consist in the type of construction, which makes it possible to use low pressure tubes, and in the ability to refuel the reactor without halting its operation. These are the main points which differentiate Embalse from Atucha I.

The beginnings of the Candu system date back 40 years. Today, with over 100 reactor-years of operation all over the world, Canadian power plants have produced 300 billion KWh of electricity, with good levels of safety and economy. According to the Canadians, these two qualities are the reasons why, at the end

of last year, five Candu reactors were among the top 10 reactors of over 150 MW power in the world, based on their load factor.

Also in 1982, according to information provided by the same source, a reactor of this type was rated the most efficient, and had completed a period of uninterrupted operation for 484 days, surpassing the previous world record by 100 days. At present there are either in operation or under construction 31 Candu reactors in six countries, with a total power of over 18 million KW. Four of these units will begin service this year; one of these is the Embalse plant which has already begun to operate in the way promised by its builders.

What contribution was made by the Italian firm? Italimpianti Societa Italiana Impianti, a member of the Iri-Finsider group of Italy, was responsible for the conventional part of the plant. It provided the complex turbogenerator unit and a thermal cycle suitable for the preheating of the feed water used in the steam generators.

It also installed the electrical systems for the transformation and distribution of the energy produced to the plant's auxiliary systems and to the national power system, by means of a 500-KV substation. The Italian group was also responsible for the application of the instrumentation and control system so that the complex could operate with complete safety. In addition, it had to begin operations of the plant by means of a 132-KV substation, and provide auxiliary services of particular importance, such as the cooling system.

Argentine firms worked in the areas of engineering, construction, the supply of materials and equipment, the execution of assembly and installation work, and the appropriate tests in each instance; all of this amounted to over 50 percent of the conventional part.

In the nuclear area, the detailed engineering work for the plant's construction was entirely done by Argentine firms. The same was true of the basic engineering for a large part of the conventional mechanical systems and the radiological protection systems. It was also true of the detailed engineering for electromechanical supplies for auxiliary systems of the nuclear part, and of the detailed engineering for assembly and installation, after the basic engineering had been provided by the international consortium.

The plant's air conditioning system, and in general its thermomechanical facilities were also provided by an Argentine firm. The firm Lix Klett handled this aspect of the work, and provided the Embalse nuclear power plant with a complete cooling system, composed of four centrifugal compressors. This system is backed up by a mechanical ventilation system composed of 10 centrifugal extractors with a capacity of 60,000 cubic meters per hour each. This revolutionary cooling system, along with the other thermomechanical facilities, is the result of the most advanced form of technology.

Because of the magnitude and responsibility entailed in their achievements, we should mention some of the local firms involved in this project: Pescarmona provided bridges, cranes, and gates; Industrias Metalurgicas Impresit-Sideco, which handled construction; Techint, which worked in the area of basic and detailed engineering; Roman, which transported all the plant's components; Nuclar, which worked on electrical assembly and installation along with Argatom; Iecsa, which worked on the assembly, instrumention, and control of the plant: Ema, which worked on the rod command and control panels; and OMICA, the sole supplier of over 50,000 meters of copper tubing for the transport of fluids.

In that way, in a give and take sort of operation, Argentina receives technology from abroad and then exports it; this has without a doubt made it a leader in the Latin American region. For the moment, its exports are confined to a low-power, experimental level, but we can not ignore the fact that some day Argentina may be a supplier of power plants, since the technology for this type of plants will hold no further secrets.

On this topic, Castro Madero explained that because of the change in export policies made by the countries providing nuclear technology, after the contract for the construction of the Embalse plant had been signed, the CNEA was forced to intensify its work on the fuel element, which required the development of highly sophisticated processes and the design of complex machinery. "Our success in that undertaking," he said, "is clearly shown by the fact that we now have our Nuclear Fuel Factory established at the Ezeiza Atomic Center. This national production line assures us of having future supplies of the fuel we need for the Embalse plant."

It is true that Argentina has already begun to export nuclear technology. One example is the case of Peru, where an atomic center is being built in cooperation with the Nuclear Technology

Institute, at the site of Huarangal, 30 kilometers from Lima. In addition, a letter of intent has been signed with Colombia, for a similar project, and a feasibility study for an atomic center in Uruguay has begun.

In the specific case of Brazil, Argentina has signed three commercial contracts with the firm Nuclebras. The first was for the loan of 240 tons of natural uranium, which has already taken place. A second agreement is for the Argentine supply of up to 160,000 meters of tubes for fuel element casings; and the third contract, with the firm KVU, authorizes the lower part of the pressure container of the Atucha II reactor to be made in Brazil.

With the start of operation of a new nuclear power plant, Argentina has just taken a decisive step forward, a step which reaffirms its decision to achieve national self-sufficiency in the nuclear area, bearing in mind the future of a nation which wants to develop the potential of both its natural and its human resources.

7679
CSO: 5100/2071

## CHANGES IN NUCLEAR TECHNOLOGY CITED BLOCK TO LOCAL INDUSTRY

Buenos Aires MERCADO in Spanish 19 May 83 pp 42-43

[Article by Norberto Malatesta: "Two Obstacles and One Objective"]

[Text] Argentina's current nuclear plan is designed to make Argentina a nation with a high degree of independence from the more advanced countries in this field. For that reason, one of the principal objectives of the policy of the CNEA [National Atomic Energy Commission] has been to increase progressively our national participation in this field. In Atucha I, for example, Argentine firms did no more than 40 percent of the work, while in the construction of Embalse, the Argentine involvement was over 50 percent of the total investment. These figures will increase with the construction of Atucha II, for after some major industrial upgrading programs, for the first time heavy nuclear components will be built in Argentina.

If things work as planned, it is hoped that by 1997, the tentative date of the start of service of Argentina's sixth nuclear power plant, there will be 100 percent national participation in construction and engineering; about 95 percent in assembly and installation work; and 65 percent in the manufacture of electromechanical components. When we remember that the present cost of a project of this nature is about $1.5 billion, it is easy to realize the dynamic effect that the construction program announced by the CNEA will have.

The evolution of this sector has made a major development of our national industry possible, but it is still no less true that the nuclear plan's 2-year lag behind schedule (a plan prepared in 1979) is of concern to Argentine business leaders. They maintain that if things continue at this rate, it will be hard to keep the professional staff in these firms which have acquired experience with Atucha I, Embalse, and now Atucha II.

The fuel processing plant that was to begin operating in 1986 is now almost 20 months behind schedule. Setbacks of a similar nature are also affecting uranium mining and processing. It can not be denied that delays of this type may thwart many of the efforts made by Argentina recently. We should then ask ourselves whether the independence we have achieved in the nuclear field, despite the constant opposition from the industrialized countries, will not in the end be endangered by our economic policy of recent years.

The constant change in technology is another point that should be recalled when trying to raise the level of involvement by local industry. In the Atucha I case, after a period spent analyzing the various bids received, the German firm, Siemens, was chosen. But the Embalse plant forced Argentine businesses to train their staff to work with a technology different from the German: the technology of the Candu system, developed by Canada. And now once more, with Atucha II, there is a move back to German technology. The question is to what extent this variation in technology will damage the industrial policy pursued by Argentina in the nuclear field.

The CNEA's chairman, Vice Admiral Carlos Castro Madero, feels that this is a legitimate question. In his view, the answer has been given by the "total independence which Argentina has to make decisions concerning its nuclear plants." In the Atucha I case, German technology was chosen because both the proposal and the financing for the plant were truly excellent. That was one of the best contracts Argentina has had in terms of economic-financial operations. When the time came to build Embalse, and it was again decided to use a natural uranium, heavy water system, the CNEA selected Canadian technology, feeling that the modular system of the 600-MW Candu type was more suitable than using two reactors each of 300 MW, as the Germans proposed. The Candu system had already proved its merits in Canada. It was then thought that Argentina's future in nuclear development would be linked to Canada. This was so true that, along with the contract for the power plant, an agreement ensuring the supply of technology that would enable Argentina to build future plants on its own was also signed.

But events proved the contrary. In the interim, there was an atomic explosion in India that drastically changed Canada's nuclear export policy. Canada then imposed very strict safeguards and conditions, even before it would begin to talk about any future power plants. It is, of course, well known that Argentina's policy on safeguards is clearly defined. While it is

true that Argentina is willing to submit to this type of control, it has done so in exchange for a technology transfer, with the condition that such a transfer take place simultaneously.

On this matter, Castro Madero's statements have always been quite categorical: "We are not prepared to sign a blank check placing all our equipment under safeguards in exchange for a technology they promise to give us in the future. It has often happened that such technology never arrives, or it comes with a great many strings attached."

Another factor was the Canadian refusal to transfer technology so that Argentina could produce heavy water, another of the essential elements for achieving self-sufficiency. That did not happen with Germany, which has provided assistance in this area.

These considerations in the end played a decisive role in determining that Atucha II would become Argentina's next nuclear power plant, while still not denying the merits of Canadian technology. Given this situation, local industry has no other alternative but to adapt to these circumstances imposed by international policy, and to adjust its professional staff to work with the currently reigning technology, despite the impact, fundamentally of an economic nature, which this may have on the firms that take part in the nuclear sector.

The objectives of Argentina's nuclear policy as set by the government are clear: to achieve self-sufficiency, to train a core of skilled human resources, and to spread Argentina's capabilities abroad. Of course, for this to happen it is necessary that the dates set in the nuclear plan be respected, and to the extent possible, that the technology not be constantly changed. We must remember that the Argentine nuclear plan is not a program of the CNEA but rather a national effort, in which the participation of Argentine industry and engineering is important.

In order to stimulate industry to play an important part in these developments, it is necessary to ensure continuity in the supply of components. In that way it will be possible to handle the major investments which industry will need to make in order to manufacture its products with a high level of quality. For the reliability of those products is what opens up doors to compete in international markets.

The importance of the nuclear industry comes from the fact that it is a high-tech activity, or rather that it forms part of the industries that are undergoing their most accelerated phase of

development, and which in turn have a great multiplying effect on other activities playing a part in our national economy. Nonetheless, the development and consolidation of our local nuclear production should be supported by the following factors, among others:

a. The formulation of an equipment plan covering a reasonable time period, estimated at 20 years;

b. The definition of the type of reactor to be used; if it is decided to use several types, to the extent possible it should be stated clearly the type that will be used in each of the projects scheduled in the plan, along with the total quantity required;

c. A firm decision to be made by the government organizations involved to put the plan into practice;

d. Specific industrial upgrading standards.

All these factors, which will provide support and consistency for this activity which has been in progress in Argentina for a number of years, and which has placed us in a favored position within Latin America, will help to ensure that Argentina's nuclear future will successfully, and at the appropriate times, proceed through its scheduled stages.

7679
CSO: 5100/2071

## CONCRETE POURING OPERATION BEGINS AT ANGRA II

Brasilia CORREIO BRAZILIENSE in Portuguese 4 Jun 83 p 10

[Text] Rio--After almost 5 years of construction work on the foundations, with the implantation of 1,364 reinforced concrete piles, they have now begin to pour the concrete for the lower portion of the reactor building at the Angra II plant. The work is being conducted by NUCON-NUCLEBRAS [NUCLEBRAS Nuclear Plant Construction, Inc], which considers this an extremely important phase of the civil construction, because this is where the 1.245-megawatt reactor will rest. About $1.65 billion has been spent on construction of Angra II and the fuel cycle.

The marked delay in construction of Angra II was basically the result of disagreements that arose some years ago between NUCLEBRAS and the FRG technicians, on one side, and the CNEN [National Nuclear Energy Commission] regarding safer foundations for the "seating" of the reactor building. Despite the delay in construction, the Germans proceeded with the manufacture of the ordered components, 65 percent of which are already completed and stored in the FRG. The cost of storage is 1 percent of the value [of the components] per year, equivalent to about $10 million annually.

At the beginning of 1983, NUCON completed the first phase of construction of the steel containment sphere for the Angra II building, and began the phase of "flotation" of the sphere. The concrete pouring operation will take about 20 months, with completion expected in early 1985. According to NUCLEBRAS, civil construction will be completed in March 1985, except for the dome and the final touches.

The reactor building's superstructure represents 40 percent of the total civil construction, and the turbo-generator building and other auxiliary buildings represent 20 percent. Work is proceeding on the reactor building and the auxiliary reactor building, the water-intake turbines and conduits, the cooling building for the condensor and the "jetty" (the breakwater to protect the water intake conduits).

About 11,400 people are working at the Angra II construction site, in addition to subcontracted personnel, such as technicians to lower the water table, geotechnicians, specialists in the area of soundings and technical crews in mechanics.

The completed equipment ordered from the FRG for Angra II are the reactor vessel, pressurizer and steam generator.

6362
CSO: 5100/2073

## BRIEFS

URANIUM CONCENTRATE TO ARGENTINA--NUCLEBRAS [Brazilian Nuclear Corportations, Inc] will ship 136.1 tons of uranium concentrate to Argentina this year, in partial repayment of the 240 tons lent by Argentina in 1981 and 1982 for the first recharge of the Angra I nuclear plant, the Ministry of Mines and Energy reported yesterday. Brazil's uranium concentration plant was inaugurated in May 1982 in Pocos de Caldas and enabled NUCLEBRAS to begin to repay Argentina, with the first shipment of 22.6 tons. During this month NUCLEBRAS will ship another 56.2 tons of uranium concentrate to Argentina. In October and November, the corporation will make two more shipments of 34 and 23.3 tons, respectively. Of the 136.1 tons that will be repaid this year, 120 tons is equivalent to half the total loan from Argentina, plus 6.14 percent in annual interest. The other half of the loan will be repaid, with interest, in 1984, the Ministry of Mines and Energy reported. The portion which NUCLEBRAS is repaying this year amounts to 27.22 percent of the annual production of the uranium concentrate from the Pocos de Caldas plant, which totals 500 tons. The remaining 72.78 percent of the Pocos de Caldas production will be sent to URENCO, a consortium formed by France, the Netherlands and the FRG to be enriched for future use in the second recharge of Angra I or for the first charge of Angra II, which is scheduled to go into operation in 1988. [Text] [Sao Paulo O ESTADO DE SAO PAULO in Portuguese 4 Jun 83 p 21] 6362

ISRAELI NUCLEAR ASSISTANCE--Cesar Cals, minister of mines and energy, met at length yesterday afternoon with Yitzhak Modai, Israeli minister of energy, infrastructure and communications, who offered to assist the Brazilian Government in the development of alternative energy technology in the nuclear area. On leaving the Brazilian ministry, the Israeli minister stated that this was "just a courtesy" visit. Describing himself as an "old friend of Gen Rubem Ludwig," he denied that his trip to Brazil was for the specific purpose of signing an accord for the transfer of energy technology. Israel, which has scientific and technical expertise in all stages of the nuclear fuel cycle, has never before sought to pass on this "know-how" to another country. [Text] [Brasilia CORREIO BRAZILIENSE in Portuguese 7 Jun 83 p 10] 6362

CSO: 5100/2073

# FIDEL'S SON CHAIRS NONALIGNED NUCLEAR ENERGY MEETING

Havana BOHEMIA in Spanish No 16, 27 Apr 83 p 59

[Article by Alberto Pozo]

[Text] The final report presented by Dr Fidel Castro Diaz-Balart, chairman of the Second Meeting of the Nonaligned Countries Movement's Coordinating Countries for the Peaceful Use of Nuclear Energy, was approved unanimously and without changes following 3 days of intensive debates and after consultation with all the delegations. The meeting was held in this capital from 12 to 14 April.

The event was marked by the great spirit of cooperation, unity of viewpoints and cohesiveness that prevailed among the delegations that attended this second meeting.

Making the closing remarks, Dr Fidel Castro Diaz-Balart recalled the characteristics of the world today, where countries of the undeveloped world are indebted by more than $650 billion, 800 million people are illiterate and 12 million children--95 percent of them born in that underdeveloped world--die annually.

He contrasted the situation of dramatic impoverishment of the underdeveloped world with the arms race and the irresponsible and excessive squandering involved in that race, adding that while some squander, others live in poverty.

Understanding and the effort of everyone to cooperate and fight foolishness, waste and, above all, the threat of extermination that hangs over all mankind like a Damocles' sword, he continued, is the world of the future.

Concluding, he said: "Distinguished delegates, let us work so that in the future nuclear energy ceases to be a symbol of threat, blackmail and potential peril and becomes a factor of development, prosperity and well-being of our peoples and of all mankind."

Lastly, Fidel Castro Diaz-Balart thanked the delegates and worked hard for the success of the meeting.

As Dr Fidel Castro Diaz-Balart finished his remarks, the delegates spontaneously stood up and applauded the chairman. This was not part of protocol, but it revealed the spirit of optimism among all the delegations.

With this meeting, the movement has reaffirmed its aspiration that the UN Conference for the Promotion of Cooperation for the Peaceful Use of Nuclear Energy is held at the proper time and when conditions have been created to guarantee its success.

For his part, India's Ambassador to Cuba, V. Khana underscored the good impression which all the delegations had had of the facilities offered and of the good organization of the meeting.

The final report includes 13 proposals to expand nonaligned countries' cooperation in that field. To these are added 11 references concerning nuclear energy and the nonaligned countries. The Ad Hoc Committee's term was extended until the Third Coordinating Countries Meeting is held.

Iraq and Iran offered to host the third meeting, and the chair made note of it.

The Israeli attack with the complicity of U.S. imperialism, on a nuclear plant under construction in Iraq in 1981 also was condemned at the second meeting.

The Iraqi delegate and others who made denunciations welcomed the approved point on the agenda referring to "other aspects that affect international cooperation in this field."

S.K. Singh opened the second meeting in behalf of the movement's chairman, Her Excellency Indira Gandhi. He emphasized that the path to be followed in coming years in the field of peaceful use of nuclear energy would be defined at the meeting. He hailed the fact that "we have returned to the generous previous host, Havana," which means continuity of this work "of which we are proud."

The next speaker was Jose R. Fernandez, vice president of the Council of Ministers and president of the Cuban Atomic Energy Commission.

"The material and human resources we have," he said in his speech, "make it possible that cooperation among our nations, properly channeled and defined, can be turned into a powerful and dynamic factor to help our autonomous and total development. That cooperation can be a positive element to develop productive, technological and commercial relations adapted to our situations and levels of development, based on recognizing the heterogeneity of our countries so as to preclude that some receive more benefits than others. Therefore, it is indispensable to start creating specific relations of cooperation wherever possible."

Concluding, he emphasized: "We are certain that we will think and act as members of a movement of countries that represents an instrument of peace, of national liberation and of economic development, and that we will work untiringly to achieve a solid and coherent cooperation among our countries.

"The current times in which we have to live require great actions and those of us convened on this occasion shall be equal to the duty and mission which history is entrusting to us."

Singh, who is India's ambassador to the UN International Atomic Energy Agency, then proposed to the plenum that "Dr Fidel Castro Diaz-Balart, who is an eminent scientist," be elected by acclamation as chairman of the second meeting, which was accepted immediately.

Dr. Fidel Castro Diaz-Balart, executive secretary of the Cuban Atomic Energy Commission and of our country's Executive Secretariat for Nuclear Affairs and head of our delegation to the meeting, spoke briefly to express gratitude for the appointment.

Others at the presiding table for the inaugural session included Foreign Minister Isidoro Malmierca, Cuban Academy of Sciences President Dr Wilfredo Torras, Ministers Joaquin Benavides, Jorge Fernandez Cuervo and Manuel Vila Sosa; and Vice Minister Manuel Aguilera, member of the Atomic Energy Commission.


Dr Fidel Castro Diaz-Balart expresses gratitude for his appointment as chairman of the Second Meeting of the Nonaligned Countries Movement's Coordinating Countries for the Peaceful Use of Nuclear Energy. Next to him are Jose R. Fernandez, president of the Cuban Automic Energy Commission, and S.K. Singh, representing the chairman of the movement, Her Excellency Indira Gandhi.

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CSO: 3248/809

## BRIEFS

FUEL SUPPLY FOR REACTOR--Dhaka, June 14 (BSS)--The United States has indicated its willingness to make continuous supply of fuel for Bangladesh's first nuclear research reactor. The DCMLA [Deputy Chief Martial Law Administrator] and minister for energy and mineral resources, Air Vice Marshal Sultan Mahmud, who just returned from a three-nation tour, said here yesterday that during his talks with senior U.S. Government officials, further assistance in support of more projects with the research reactor was also discussed. A 3 mw research reactor worth 5 million dollars has been procured from the United States and will be installed at the Atomic Energy Research Centre in Savar, about 30 kilometres from here, he said. The reactor is expected to go into operation before the year is over, he added. Air Vice Marshal Mahmud who also visited Canada and France held substantive discussions with government ministers and heads of organisations of further cooperation in the energy sector, with particular emphasis in the field of petroleum. [Text] [Dhaka BSS in English 14 Jun 83 p D 1]

CSO: 5100/4717

## FUNDAMENTALS OF NUCLEAR POWER PRODUCTION DISCUSSED

Rabat AL-'ALAM in Arabic 23 May 83 p 2

[Article by Muhammad al-Mahdi (Banani): "Morocco on the Threshold of Having Nuclear Power For Peaceful Purposes"]

> [Text] Moroccan-French cooperation to open up a new page of permanent relations.
>
> Morocco's future annual electric power requirement will be 17.3 billion kilowatt-hours.
>
> Morocco is on the threshold of having advanced technology in the field of nuclear power stations.

Rabat was the scene of a Moroccan-French nuclear power conference on 10 and 11 May of this year. During the conference the Moroccans presented their assessment of their situation--which is that of a country searching for new sources of energy which it has an increasing need for year after year--and stated their determination to press on with their plan to construct nuclear plants to produce electric power. The French stated their opinion concerning the importance of France's expertise in the field of nuclear technology used for peaceful purposes. They also stated their readiness to help Morocco solve this vital problem since solving this problem is essential in order to achieve any future industrial progress which would bring Moroccan society the economic and social benefits that would enable it to take great strides forward and spare it the consequences of the energy crises which have been jolting the world ever since the early seventies.

We are haunted by the specter of our requirement for energy which every year drains a large share of our foreign currency reserves and we are haunted by the specter of famine which is looming larger every year because of our growth in population and could upset the proportional relationship between the increase in our GNP and the need for the food which our people's stomachs must have. All the efforts being made in this area and the wholehearted zeal of all of our scientists and technicians at the present time to use their capacities to build a better future constitute a mission which is the culmination of the job begun by our forefathers and passed on

to us. We, in turn, will be accomplishing work, the results of which will benefit our descendants in the future.

The challenges which we face are large ones. Initially these challenges involve the production of energy, industrial production, agricultural production, and food production, and ultimately they involve safeguarding the lives of our Moroccan citizens in both the present and the future as mankind struggles to attain a decent existence, aspires to have a better life, and works on eliminating backwardness, misery, poverty, hunger, lack of decent clothing, sickness, ignorance, and being deprived of a secure livelihood. Perhaps these momentous days during which the French and Moroccans discussed nuclear power will result in steps being taken which will embody many of the hopes that we have begun to cherish.

Ambitious Moroccan Nuclear Program

The Moroccans, when presenting their program dealing with using nuclear energy to produce electric power, began with a summary of the situation which stated that nuclear activity in Morocco at the present time is restricted to fields not related to producing power--such as the fields of medicine, agriculture, and industry. As a result of testing which has taken place in an effort to bring nuclear power to Morocco, an electro-nuclear program has been established. The program constitutes the basic elements of the energy plan which has the objective of minimizing Morocco's dependence on other nations for its sources of energy--at the present time Morocco imports more than 80 percent of its energy needs--and making sure that Morocco's national sources of energy will be more diversified. Studies dealing with meeting the country's demand for electricity indicate that, by the years 1993 and 1994, the country's maximum production--using its own primary sources of energy, including coal, water power, and shale oil--will not exceed 10.7 billion kilowatt-hours. By that time, however, the country's electricity requirement will be 17.3 billion kilowatt-hours, and by the year 2000 this requirement will be 26.7 billion kilowatt-hours.

If we have not started utilizing new national sources of primary energy for the production of power by the period between 1993 and 2000, then we will have to use some other means to produce the [additional] 16 billion kilowatt-hours per year which we will be needing by the year 2000.

This explains the need to resort to nuclear power to produce electricity.

A study of Morocco's long-range energy supply program reveals that, in order to meet the country's need for electric power between the years 1993 and 2000, four nuclear power plants for the production of electricity, each having a capacity of 6,000 MN, must be constructed, and in order to achieve this a new plant must be constructed about every 2 years.

Furthermore, in 1983 the National Electricity Bureau will undertake a technical and economic feasibility study and will choose a location for the first nuclear power plant, which will be constructed by the French company (Sufratom).

With the help of two French firms and the Ministry of Energy and Mines, a program has been established which involves three key elements--the creation of legislation dealing with nuclear power, the formation of a legislative commission [to deal with nuclear power], and the hiring and training of employees [to work in nuclear plants]. The national energy program anticipates the creation of a national nuclear energy center which will provide scientific and technical support for Morocco's nuclear program.

Morocco is well-endowed when it comes to meeting the requirements of the nuclear fuel cycle since it has uranium, associated with phosphate, theoretically estimated as totalling about 9 MT. Therefore, starting in 1988, Morocos intends to produce about 200 tons of uranium oxide per year by utilizing the phosphoric acid of the Moroccan Phosphate-1 [Company] and the Moroccan Chemicals-1 [Company] and Moroccan Chemicals-2 [Company], which are both located in Safi.

French Expertise in Nuclear Power Technology

The French, for their part, concentrated on demonstrating French capabilities and expertise in the field of advanced technology in the realm of nuclear power, and showed both what they had achieved in France itself as well as what French experts had done in projects in this field in other countries.

Their data included the production contribution in 1982 made by the group of nuclear plants operating throughout the world [which had been built by the French], stating that it was the equivalent of 196 million doctors [as published]. According to the data, the number of reactors operating totalled 295, their capacity was 28 MW(E), and 40 percent of the reactors were pressurized water reactors. This seems to indicate that nuclear power is an important factor in the diversification of [France's] sources of energy, especially since France has in mind to minimize its dependence on oil as a source of energy and has moved in the direction of diversifying its available sources of energy, which include coal, water power, and some new sources of energy. France will be depending on nuclear power, and beginning with the year 1990 about 70 percent of the electric power utilized in France will be produced by nuclear plants. This is why the "French Electric [Company]" in 1973 began the construction of a standard series of nuclear plants of the 900 MW(E) and 300 MW(E) categories, all of which use pressurized water reactors. French industries, for this nuclear power development program, constructed all the basic buildings for these plants, and only French labor and resources were utilized. Thus the French have acquired skill and expertise for dealing with the nuclear fuel cycle--including the processing of uranium, enriching it and preparing it [for use in reactors], and disposing of nuclear waste material.

As of today, in 1983, [Franch has] some 23 nuclear plants using pressurized water reactors, and they produce about 40 percent of France's electric power. As far as production cost per kilowatt-hour is concerned, for the French it is about half as expensive to use coal and about two-thirds as expensive to use fuel oil. In their presentations, the French referred to their technology for processing nuclear fuel and disposing of nuclear waste

material in such a way as to protect the environment and meet security and inspection standards, and they referred to the reputation of France's nuclear industry as being one for peaceful purposes which engages in the implementation of projects involving the construction of nuclear plants in foreign countries which are utilized to supply electric power or to desalinize seawater and thus provide drinking water to areas otherwise deprived of it. There are such projects which have either been completed or are in the process of being completed in Belgium, South Africa, Iran, and South Korea, and desalinization plants have been, and are being, built in some of the Arab countries.

The basic works written concerning the field of nuclear power plants include a book written in Czech called "Nuclear Plants." The introduction to this book furnishes us the following information: Worldwide consumption of all types of energy today is increasing at a rate of more than 4 percent per year, which means that energy consumption is increasing twice as fast as the increase in the world's population. This rapid increase in energy consumption has bearing on various important issues such as technological, economic, and health issues. This is why people in the world today are becoming increasingly interested in utilizing nuclear power.

Nuclear reaction involving the slow fission of neutrons is all that is used on the industrial level today. Many basic problems have not been fundamentally solved. Furthermore, nuclear plants today are producing only 8 percent of the [world's] total electric power. But the total capacity of the nuclear plants is rapidly increasing, and by the end of this century it will be possible to produce half of the [world's] electric power by means of nuclear plants.

## The Nature of Nuclear Power

Total fission of 1 kilogram of energy material is equivalent to power which is equal to 9.0 x 10 power 15 joule. No matter what principle is utilized for the total fission of such material, this process has still not been carried out on the industrial level. After the splitting of the nucleons of the light nuclides, partial fission of the material occurs or during this time whatever material is left over is released in the form of nuclear energy. Nuclear energy is mostly kinetic energy of the nuclides formed and shows up on the microscopic level as thermal energy. It is possible for energy to be obtained during the formation of the deuterium nucleus and the tritium nucleus. Also it is possible for energy to be obtained during the fission of one atomic nucleus of uranium.

## Methods of Releasing Nuclear Energy

During the contact of two nuclei of the light nuclides in a nuclear chain reaction, it is necessary to overcome the barrier of the repulsive electrostatic forces, and this requires considerable kinetic energy. The same thing is true in the case of a heavy nuclide, which must undergo fission as a result of the loss of internal stability since it must undergo excitation

in a nuclear chain reaction by means of a high degree of energy. This can take place by means of capturing a nucleon, which its link has, and kinetic energy. The same thing is true in the case of excitation of uranium.

For industrial obtainment of nuclear energy it is insufficient to carry out an isolated nuclear fusion or fission chain [reaction]. This is because it is necessary to carry out a chain reaction during which, at the end of one basic nuclear chain [reaction], there occurs the formation of the same chain [reaction] in the new nuclides of the next generation. The chain reaction occurs during the nuclear fusion because of the heating up of the light nuclides reacting by means of sufficiently high energy.

After that the thermal energy formed as a result of the nuclear fusion in one generation is directly used to raise the kinetic energy of the next nuclides which still have not participated in the reaction--that is, to carry out the same nuclear reaction in the next generation. The chain reaction in the nuclear fission of the heavy nuclides occurs by means of neutrons released radioactively during the fission.

These neutrons, which are called "accelerating neutrons," have kinetic energy and can be used in the ideal case of successive fissions, that is, in the case of heavy nuclides which have not yet undergone fission in the next generation.

Among the heavy nuclides preferred for this purpose are [those of] thorium and uranium, which are both found in the ground, and some types of uranium which are artificially created. A captured neutron in uranium does not require any kinetic energy for the excitation of a fission reaction. For this reason it is possible to achieve uranium fission by means of slow neutrons--even in cases where their kinetic energy is sluggish and weak and their temperature is room temperature and that of the surroundings. Such neutrons are called "thermal neutrons."

Nuclear Reactors and the Chain Fission Reaction in Them

The part of the nuclear reactor in which the nuclear energy is released by means of an apparatus where the chain fission reaction is maintained is called the active area of the core.

The actual active area, with its physical properties, differs from the ideal fission environment. This is why the circumstances or conditions for maintaining the chain fission reaction in it are complicated. Only a portion of the neutrons in fission which are combined by nuclear fuel can bring about fission again. The remaining neutrons are captured. After the occurrence of certain nuclear reactions which are sometimes complicated, a new nuclide which has undergone fission is formed and this sequence is called the "nuclear focus" or "nuclear propagation," depending on whether the number of newly-formed nuclides which have undergone fission is less or more than the number of nuclides which have [only] undergone fission.

Those neutrons which are in fission are never combined by the nuclear fuel. They either escape the active area or are absorbed in productive fashion in their component materials or in the product of waste material of the fuel which has undergone fission.

It is necessary, in order to maintain the fission reaction, to guarantee the same number of the neutrons which cause the fission in all the generations. This state of balance of the active area is called the "critical state" and is matched, because of certain physical conditions, by a certain quantity of nuclear fuel called the "critical mass." The number of neutrons in the fission is always larger than the number of neutrons causing the fission. This competition ranges between about 2.5 and 3.0.

Nevertheless it occurs, and occurs easily. In fact it is impossible to reach the critical state in the active area touched.

The use of slow neutrons is considered to be an important factor which, in some cases, facilitates and enables the attainment of the critical state, as is the case with natural uranium.

Methods of the Mechanism of the Chain Nuclear Reaction

In order for a nuclear reactor to operate at a capacity of 1 kilowatt-hour it is necessary to carry out some degree of fission in its active area. Unlike the traditional means of obraining energy in which the capacity increases with the increase of the quantity of fuel involved, the quantity of nuclear fuel in the active area of the reactor stays the same. The mechanism of the capacity is based on the principle of inducing the intensity of the chain fission reaction.

The average life span of one generation of immediate neutrons--that is, neutrons immediately released during fission in the active area--is very short. Any positive deviation from the critical state in these immediate neutrons could, with fast neutrons, lead to a nuclear explosion. Even with slow neutrons it could lead to a rapid increase in capacity which cannot be controlled by progressive means of an automatic mechanism. For this reason it will never by possible to allow the possibility of the critical state in the immediate neutrons [to be used] in the application of reactions.

When directing the capacity it is possible to introduce a change in the critical state of the active area in manh of its various physical properties. Usually what is directed to the active area is sufficiently absorbed. A portion of the neutrons are absorbed and this diminishes the portion of the neutrons causing fission. It is also possible to change the quantity of nuclear fuel in the active area, to change the size of the reflector, and to change the quantity or properties of the transmitter in nuclear reactors having slow neutrons.

The Nuclear Reactor As a Complete Function

A nuclear reactor constitutes an apparatus in which a nuclear fission chain reaction is maintained. Reactors can be classified in accordance with their purposes as reactors for use in schools, experimental reactors, production reactors "for the production of uranium conversions," [reactors which serve to] convey ships and missiles, [reactors which produce] permanent [sources of] energy, and reactors for special purposes such as those for conveying and those for [producing] energy.

Every nuclear reactor serves numerous purposes. Thus the main objective of permanent energy reactors is to produce a large volume of energy in a given location. This is why nuclear energy reactors are the basis for generating energy from nuclear fission. The building f a nuclear reactor has to take into account some of its basic functions such as the placing of the nuclear fuel in the active area, slowing down the neutrons in fission in operating reactors by means of slow neutrons, the mechanism of the chain fission reaction, and the release of thermal energy from the active area. The nuclear fuel is placed in the fuel columns, which are usually rods or a bundle of rods covered by special construction material. The greater part of the energy from nuclear fission is generated in the fuel rods, and the covering protects the nuclear fuel from rusting due to the environment, prevents the leakage of atomic radioactive products which have undergone fission, and in some cases even allows the function of the special part carried by the fuel column.

The transmitter is smaller than the kinetic energy of the fast neutrons in fission. It can constitute, together with the nuclear fuel, a homogeneous mixture or solution or a non-homogeneous system supplemented by the transmitter. Usually the active area is surrounded on the outside by a reflector, called the "escape of the neutrons," and usually it is made of the same material as the transmitter.

The capacity of the nuclear reaction is set in motion directly in the active area or in the reflector, usually by means of driving rods which contain a powerful absorber of neutrons [consisting of] boron or cadmium or by means of moving fuel columns. The cooler surrounds the fuel columns and from it the thermal energy is propelled from the nuclear fission. This energy is conducted to the outside of the nuclear reactor. In some energy reactors the substance used as a cooler is various gases such as carbon dioxide gas and helium or some liquids such as light water, heavy water, or steam from light or heavy water, and sodium. Usually the cooler is selected from the same type as the transmitter.

Today energy reactors are being constructed which operate with slow neutrons as non-homogeneous reactors. There is also a large number of twins of individual types of fuel, transmitters, and coolers. Usually nuclear reactors are constructed in pressure containers, and in some cases they have pressure channels.

Nuclear Plants

[Nuclear plants] constitute industrial installations which, by means of nuclear fission, produce thermal energy which is gradually converted into the desired electric power within the limits of distinctive criteria. When this happens it is possible to use some of the thermal energy in the nuclear reactor. A nuclear plant consists of one or three [circuits] as well as some auxiliary circuits.

The cooler is in the first circuit, and it is a nuclear radiator. The inactive steam flows in the second circuit. The two circuits are separated from each other by the heat exchanging areas of the fuel generator. In some cases the second circuit might be dispensed with and the cooler of the radioactive activity is placed in a turbine apparatus or sometimes, for reasons of safety, another main circuit is placed between the two circuits and there are changes in the heat associated with it. This is the case when cooling a nuclear reactor with sodium. To the circuits is added a fuel economy auxiliary, a liquid transmitter circuit, and other things such as a circuit for eliminating active residue and circuits for cooling the reactors in case of accicents. Present electricity-producting nuclear plants and traditional electricity-producing plants closely resemble each other and differ [mainly] in one way: Nuclear plants have elements which are strongly radioactive, and even particles. They produce products which have undergone fission and are highly radioactive, and even active nuclear waste materials. The energy reactor itself represents activity which is equivalent to several thousand tons of radium.

For this reason nuclear power plants involve the taking of some special measures to guarantee safety from radioactivity.

Chemical and Fuel Evaluation at Nuclear Plants

At nuclear power plants based on using nuclear fuel one obtains less energy--as has already been mentioned. This limitation is attributable to the physical and technological properties of the nuclear fuel, to the nuclear fuel itself, and to the dynamic and technological properties of the nuclear plant.

Only natural uranium can be used as a nuclear fuel in its natural state after nuclear fission. Mostly enriched uranium is used as nuclear fuel in operating reactors, and the ignited fuel is very valuable from the standpoint of energy. For this reason it is chemically treated and put back in the nuclear reactor. This makes it possible to raise the energy yield of natural uranium. During the production of electric power at a nuclear plant it decreases from 30 to 40 percent. If the combustible nuclear fuel is chemically treated, it is possible to raise the energy yield.

Nuclear Yield

Nuclear energy constitutes a complex branch of a country's production activity, the objective of which ultimately is to produce a sufficient

quantity of inexpensive power. But one cannot simply reduce the problem of nuclear energy to one of building and operating electricity-producing nuclear plants.

Nuclear energy is part of a particular high-level energy system. Whenever energy production is greatly increased, this must be accordingly adapted to the requirements of this system in terms of reliability and safety of operation, the cost of the energy produced, the extent of participation, and the adjustment of the system's capability. Nuclear power requires the existence of a complex series of industrial establishments whose fuel cycle is complete. The cycle begins with the uranium and thorium mines or the extraction of it from minerals in which it is found, as is the case in Morocco where there is a lot of phosphate. The cycle then continues with the preparation of the chemical processing of the nuclear fuel and then enriching it for the production of fuel columns. Then there are the plants which chemically treat the ignited nuclear fuel, and finally the cycle actually ends with the preparation of the elimination and long-term storage of the radioactive waste material.

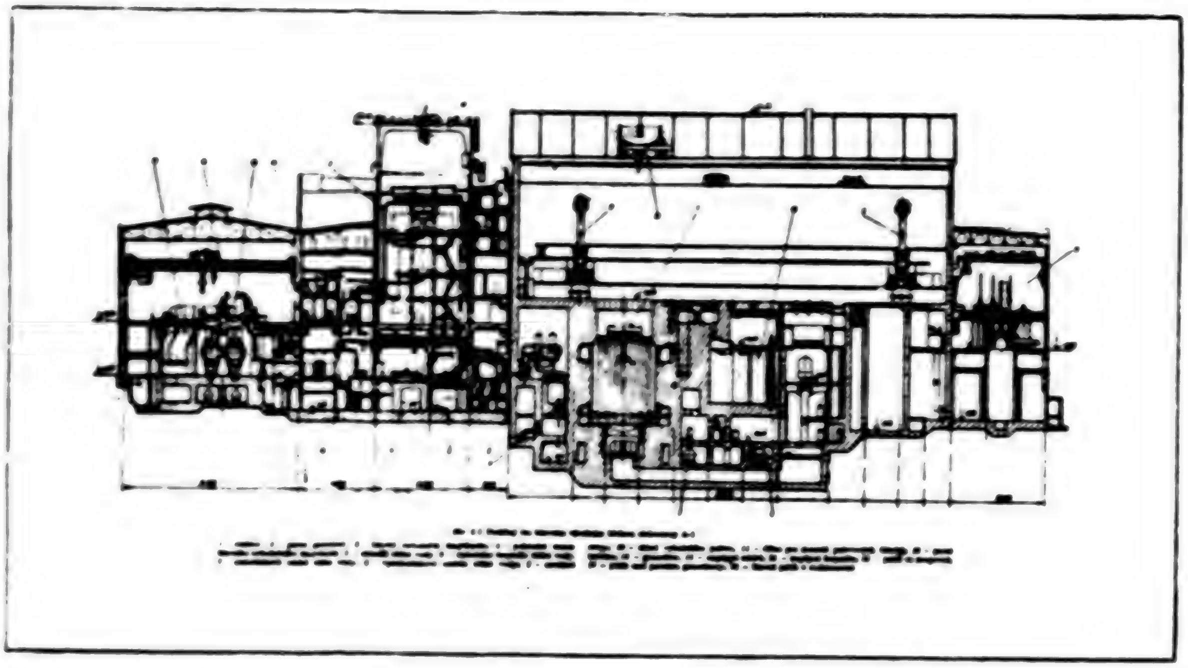
Nuclear energy can exist only if a nation's society has reached a certain general level of industrial development. It requires a high degree of intellectual maturity and academic specialization. It also requires organized [teams of] specialists, a wholesome international division of labor, sufficient technical extertise, and large-scale production, economic, technological, and scientific activity.

The Broad Significance of Nuclear Energy

The task of nuclear power does not stop with providing a nation's society with all of the energy that it needs. Nuclear energy must also participate in solving the vital problems of an industrial society. This includes the problems of providing this society with raw materials and food as well as providing it with an acceptable environment.

When efforts are being made to solve the raw materials problem, it is the job of nuclear energy to provide sufficient quantities of electrical and thermal power so that the country's soil can be economically treated, especially when the soil is poor in terms of content of raw materials. Nuclear power should thus allow the other traditional fuels to be used as chemical raw materials which do not necessarily need to undergo combustion for energy purposes.

As far as the problem of feeding society is concerned, this involves the desert areas whose people require drinking water--which can be economically obtained by means of the desalinization of seawater. Industrial fertilizers are also necessary in order to make agricultural production more intensive. It is also necessary to have a large amount of electric and thermal power in order to desalinize seawater. And nuclear power, by means of treating waste, participates in solving our vital environmental problems.



Sample of the Design of a Nuclear Plant

9468
CSO: 5100/4606

# NEED TO BUILD ADDITIONAL NUCLEAR POWER STATIONS REPORTED

Johannesburg THE STAR in English 26 May 83 p 10

[Article by J. Manuel Correia]

[Text] South Africa will have to decide within the next two years on a comprehensive programme for building nuclear power stations, but the problems to be faced, financial and otherwise, are daunting.

Energy experts agree that this country has no option but to build more nuclear power stations and that because of scarce inland water resources they will have to be sited at the coast.

They see the drought — and the power cuts possibly arising from it — as driving home forcefully to the authorities a greater awareness of energy problems and the need to plan for a nuclear future now.

But they also point out that building another nuclear power station now will be no panacea for any droughts that might come in the next decade.

Escom has, it is understood, investigated several coastal sites for nuclear stations. Understandably, nobody will say where.

If the Government decided tomorrow that it wanted another nuclear power station built as soon as possible Escom would be in a position to do so at Koeberg, because it owns the land next to it.

There would be no engineering problems, but there are other factors to consider — including opposition by environmentalists and the panic button syndrome — in any possible Koeberg 2 option.

It is, therefore, logical to assume that the next nuclear plant will not be built at Koeberg and unlikely that another nuclear power station will be built within the next four years.

Because of the exacting construction and technology involved it would not be operational for another decade or so.

What is bedevilling the country's nuclear programme is cost. The original contract price for Koeberg was R972 million.

Inflation and other factors had pushed this cost up to R1 800 million by this year

The next power station could easily cost double this — a sum Escom would find an extremely heavy burden.

South African industry is itching to take a bite at the nuclear cherry, but the experts warn that a nuclear programme is not to be undertaken at the breakneck speed of putting up a 50-storey building.

Some years ago I discussed breeder reactors with a prominent nuclear scientist and he foresaw they would be built one day in this country.

However, experts today say that breeder reactors — reactors which manufacture their own fuel — available commercially are beyond the resources of this country.

They will be built, certainly, but probably only around 2050.

CSO: 5100/45

DANISH MINISTER REFUSES TO ACT TO HALT SWEDISH N-SHIPMENTS

Copenhagen INFORMATION in Danish 16 Jun 83 p 3

[Article by Alex Frank Larsen]

[Text] "I see no reason for further investigation," says the minister of environmental affairs, Chr. Christensen (Christian People's Party) in commenting on a Danish campaign against the Swedish shipment of spent atomic fuel through Danish waters.

The Organization for Information Regarding Atomic Energy (OOA) has just finished up an extensive collection of signature which will be used to support the demand to stop nuclear shipments to--among other places--the Barseback power plant by the nuclear ship "Sigyn."

The OOA is proposing as a minimum demand that the Danish Government should request the Swedish authorities to stop the runs until there is a "thorough and reliable analysis of the risk which the transportation poses to Denmark."

Up until now the risk has been judged on the basis of foreign theoretical calculations. They don't take into consideration special Danish conditions, the density of population, heavy traffic in Oresund and Storebaelt, fishing, or the increased traffic of oil and gas tankers which constitute the greatest danger in connection with the nuclear shipments, the OOA maintains.

The Danish authorities have "disastrously failed" by not requiring such investigations before approving the Swedish crossings and by "completely uncritically accepting a superficial Swedish risk evaluation, full of mistakes, rather than protecting Danish interests," Tarjei Haaland of OOA said.

The Matter Is Not Over

The minister of environmental affairs, Chr. Christensen, tells INFORMATION that he sees no reason for further Danish investigations.

"Our request to the Swedish minister to include the transportation problems in the Oresund in the special Barseback committee was, as is known, rejected, but the matter is not clear up with that. We have received an invitation from the Swedish minister to discuss the matter when the report on the

"groundings of 'Sigyn' are ready. We have been pressing for an answer but we have not received any data for a meeting. The agreement is under consideration and we'll not take any action until the report is available.

"The report concerns only the nuclear vessel, but OOA's demand involves concrete investigations of many other aspects of the crossings.

"The decision of the Danish parliament was that one should ask the Swedish Government for a more detailed investigation of the problems involved in the transportation. Naturally, we are not satisfied with the rejection concerning the Barseback committee, and the first thing now is that the matter will come up again in a meeting between the Swedish minister and the undersigned."

Big Differences

The Swedish Government is of the opinion that the matter has been negotiated to a resolution and that Denmark has accepted the Swedish transport plans. Minister of Energy Birgitta Dahl has agreed to reopen the question but without proposing any changes in the prospect.

The OOA blames the Danish environmental authorities, that is, especially the environmental board, Supervision of Nuclear Installations and the State Institute for Radiation Hygiene for having accepted on a very casual basis the nuclear shipments through Oresund and Storebalt.

The OOA alleges that only after public uproar has the changing Danish environmental affairs ministry raised doubts about the shipments through Oresund by, among other things, challenging reports from meetings between the two countries' officials.

Danish authorities last summer explicitly stated that they preferred nuclear shipments through Storebalt over Oresund. It was emphasized that the two waters were judged to be "navigationally equal" but not equally suitable for nuclear shipments, and it is in regard to this that the Danish-Swedish struggle continues.

Skepticism

The OOA campaign is based on [illegible] p skepticism regarding the Danish acceptance which implies that [illegible] ughly six nuclear shipments annually can increase to almost 150 per ye[illegible]

Acceptance was based on the so-called Final Safety Report of the Swedish authority SKBF [Swedish Nuclear Energy Development Commission], which estimates the consequences of the most serious accidents at 1-2 cancer fatalities per year. This will occur if 10 transportation containers are subjected to intense fire for an hour and a half in a collision with an oil or gas tanker.

Tarjei Haaland has in the OOA's paper ATOMKRAFT compared this assumption with other calculations which call attention to radioactive leaks which are 50,000 times greater and consequently will have far greater consequences.

The difference stems from the fact that the Swedes assume that a fire will last at the most an hour and a half if a nuclear ship collides with a tanker, while an English report calculates the duration of the fire at 9 hours, that is, the time necessary to burn holes in the waste containers.

While the Swedes are calculating on a leakage of one percent of the very radioactive caesium 137, the English PERG [Production Emergency Redistribution Group] report estimates on the basis of the so-called Rasmusen report's calculations on a leakage of up to 50 percent. The difference per container is 3.74 curie in the Swedish report and 187,000 curie in the English.

Each shipment via the "Sigyn" includes 4-5 waste containers with a total of about 40 percent of a Barseback reactor's content of longlived radioactive matter.

No Danish Analysis

The Danish authorities have not gone into these discussions with their own investigations but have without further documentation stated that that caesium essentially will be retained in the containers.

The State Institute for Radiation Hygiene has not, writes Kaare Ulbak from the institute, "undertaken a comprehensive, independent safety analysis of the sea transportation of spent core fuel including the Swedish sea transport plan but has looked at the validity of a number of the assumptions made in the PERG report."

Tarjei Haaland from OOA adds, "Why in the world has SIS not undertaken an independent safety analysis of the Swedish sea transport plan? It is clearly SIS's task to evaluate the health risks associated with the Swedish shipments of atomic waste in Danish waters. And all the more so since the Final Safety Report did not at all evaluate the possible health and environmental consequences of a leakage as a result of an accident in Danish waters through which the shipments would go.

"Why have the Danish authorities not laid such calculations of the consequences on the table? Possibly because likelihood of an accident is so small that it is not worth the trouble. That excuse was also used at the beginning of the Barseback affair. But pressure from the people and the politicians gradually lead to a recognition that accidents with very great consequences should be examined even if the probability was very small. Obviously this should be the case also in this matter," Tarjei Haaland writes.

6993
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# FRAMATOME RESEARCHES UNDERMODERATED REACTOR TO CONSERVE URANIUM

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[Article by J.P. Millot, director of Framatome's Advanced Studies Service]

[Text] Are undermoderated reactors--in which the core conversion rate is increased through a reduction in the moderation ratio--of some interest in economic and strategic terms? Some major companies, such as KWU and Babcock, have done some research on this type of reactor in recent years. In France, Framatome has conducted a preliminary series of analyses, as described by J.P. Millot in this article.

## Introduction

The production of electricity from nuclear energy is now based on the use of PWR [Pressurized Water Reactor] systems. These reactors produce energy at a cost that is of economic interest, but they do consume large amounts of raw material: natural uranium.

Other types of reactors have been developed in order to achieve a better use of the fissile material. In France, this effort has concentrated on RNR [Fast Neutron Reactors]. This work has shown the value of these reactors in terms of conserving the raw material used. However, current evaluations suggest that the price of the energy produced by these reactors will be higher than the cost of energy produced by a PWR, because of the higher investment costs, with the fuel cycle costs being in line because of the present abundance of uranium.

For this reason, it may be of interest to try to reduce the consumption of uranium in a PWR in order to make a compromise between its economic interest and the interest of an RNR. Such an attempt has been made in recent years by KWU and Babcock, by

increasing the core conversion rate through a reduction in the moderation ratio. At Framatome, we have also done a preliminary analysis of this type of reactor in order to judge its interest, and also to determine the technological difficulties that might arise during its eventual development.

The characteristics of an example of an RSM [Undermoderated Reactor], as indicated below, reveal the possibility of such a compromise. As we shall see, in order to limit the uncertainties in evaluating such a reactor, we made maximum use of existing technologies: PWR technology for the boiler, and RNR technology for the fuel.

The example used is a 3,800 MWth boiler unit with four primary circuits (or 1300 MWe) so that it can be compared with a PWR reactor (Paluel) of the same electrical power, all of whose characteristics are well known.

Outside of the reactor core, the RSM has the same basic primary circuit elements as those of a PWR, except for some minor modifications. It follows, then, that the investment cost for an RSM should be very close to the investment cost for a PWR.

A study of the fuel cycle cost has been done. It showed that the cost per kWh produced by the RSM was equivalent to the cost of a kWh produced at Paluel.

For a given nuclear RSM unit, there are two possible cores:

a. a core called RSME [Raw Material Economizer/Undermoderated Reactor] with a fissile fuel of natural uranium and plutonium, which consumes only about 10 percent of the natural uranium needed for a PWR;

b. a core called RSMC [Raw Material Converter/Undermoderated Reactor] using a fissile fuel with a base of enriched uranium and plutonium, which consumes only about 50 percent of the natural uranium needed for a PWR.

The RSMC, which produces large quantities of plutonium, can increase the speed of penetration of the RSME units, which will otherwise be slow, as it is dependent on the production of plutonium by PWR units.

In this article, we will present in succession:

a. a description of the characteristics of the RSM unit;

b. an example of analysis of the strategic interest of an RSM in terms of utilization of the raw material and integration in the French nuclear power plant system;

c. an economic study of the fuel cost and its sensitivity to variations of its main components;

d. a parameter sensitivity study.

## I Description of the Boiler

### 1.1. General Comments

The undermoderated reactor responds to the desire to conserve the raw material used in this instance, natural uranium, by increasing the conversion rate, defined as follows:

$$C = \frac{\text{Number of captures in fertile material (U 238)}}{\text{Number of absorptions in fissile (U 235; Pu 239; Pu 241)}}$$

This conversion rate measures the reactor's capacity to transform by capture the fertile material (U 238) into fissile material (essentially Pu 239), which may then be reused in a reactor after reprocessing.

The interest of such a reactor, in terms of its inclusion in the French power plant system, will be studied in section II. Here we will simply give a few of the concepts which guided the project.

a. In order to increase the conversion rate, the neutron spectrum must be shifted toward the rapid and epithermal energy domains, in order to take advantage of the strong absorptions of the resonances of U 238.

This shift is done in the RSM by means of a decrease in the volume of the moderator (water) in relation to the volume of fuel ($UO_2$ or $UO_2$-$PuO_2$).

| Type of reactor | Moderation ratio ($V_{H_2O}/V_{UO_2}$) |
|---|---|
| PWR (Paluel) | 1.66 |
| RSM | 0.51 |

b. The second concept related to the RSM involves the use of the experience acquired with the conventional PWR.

In this way, we can attempt to limit the inevitable investment costs related to the start of a new project.

For example, for everything related to the steam generators, the primary pumps, and the general facility, we made maximum use of the PWR equipment (of the Paluel type). We did, however, incorporate some changes in technology in order to design an optimized and competitive reactor.

c. In the same way, based on obvious similarities, we tried to make maximum use of the RNR experience for the fuel.

1.2. Evolution of Materials; Limitations

The RSM nuclear reactor is a boiler with a thermal power of 3,800 MW with four circuits.

The main changes concern the core and its environment; in addition, some incidences on systems and the point of functioning of the primary pumps should be mentioned.

We will assume that the undermoderated reactor core will be placed in a boiler of the Paluel type, and will not repeat here the description of the primary circuit. We will simply give a description of the reactor core.

1.2.1. Core

The RSM tank is identical to the Paluel tank in its diameter. The height was reduced in proportion to the reduction in height of the fuel rods. The same is true for the internal equipment.

The reactor core includes:

a. 199 fissile fuel assemblies. These are hexagonal in shape. The rods, with a diameter of approximately 9 mm, are sheathed in stainless steel. The total height of the fuel is 2.35 m. This measurement includes the upper (20 cm) and lower (30 cm) axial coverings made of depleted uranium oxide.

The fissile fuel used may be:

1. either a natural uranium/plutonium mixed oxide; in this case, the RSM is an RSME (Economizer);

2. or an enriched uranium/plutonium mixed oxide; in this case, the RSM is an RSMC (Converter).

The fuel consists of pellets of powdered $UO_2$-$PuO_2$ mixed oxide. The plutonium used can be the plutonium removed from PWR units.

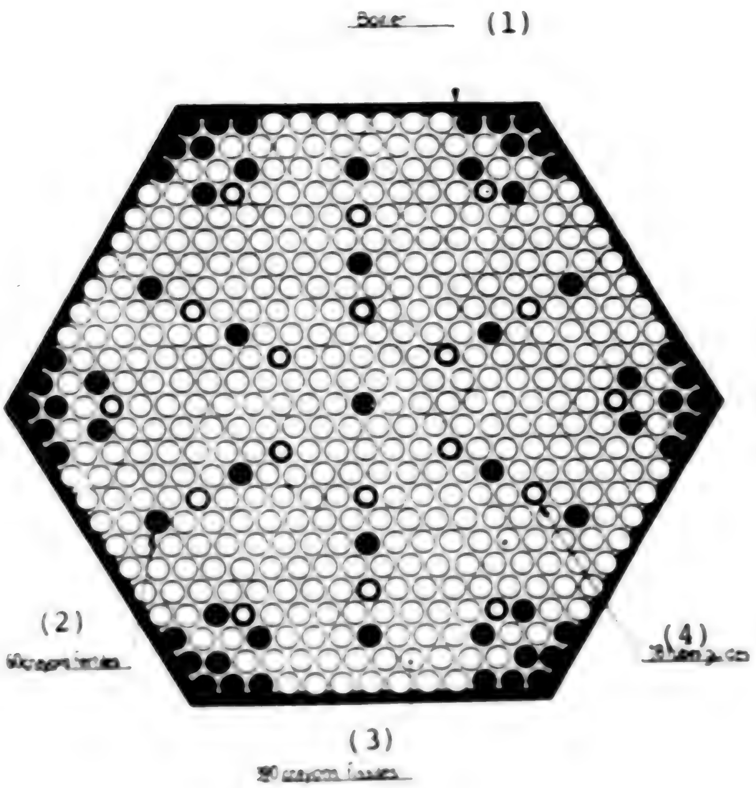
The low moderation ratio (0.51) requires the use of a triangular type of system. A preliminary choice was made to use steel wires wound in spirals around each rod, and attached to each end by soldering. In this way, the grids of the conventional PWR are eliminated. In order to maintain the structure of the rod clusters, we used a hexagonal steel casing about 2 mm thick, with grooves on the inside in order to eliminate part of the excess water created by the hexagonal design. The distortion of the moderation ratio near the edge of the assembly (interassembly layer of water) does create power peaks. To limit these peaks, rods containing natural uranium (possibly with samarium) are arranged in the angles of the assembly, thus forming an internal covering, which is involved in the production of plutonium.

The use of a steel canning sheath for the fuel rods should make possible an increase in the average discharge combustion rate in relation to a fuel sheathed in zircaloy. We assumed that it was possible to achieve a combustion rate of 64,000 MWJ/t. This increase in the combustion rate makes it possible to compensate, in terms of the cycle cost, for the additional absorption caused by using steel sheaths.

b. 54 fertile assemblies made of depleted uranium surround the fissile core. As the diameter of the rods was increased with constant spacing being maintained in order to increase the mass of U 238, the moderation ratio in this radial covering is 0.31.

This radial covering, formed of a layer of assemblies with only depleted uranium rods, with a lower moderation ratio than in the core, acts as a reflector and increases the production of plutonium (about 30 percent of the fissile plutonium produced).

In addition, the rods of the fissile core are extended (by changing the type of pellets in a rod) by two regions of 20 cm and 30 cm, which act as an axial covering in depleted $UO_2$ (accounting for approximately 25 percent of the fissile plutonium produced).




RSM: Cross Section of Fuel Assembly

Key:

1. Casing
2. 60 fertile rods
3. 390 fissile rods
4. 18 guide tubes

The use of this casing does make it possible to distribute the flow of the primary fluid between the fissile assemblies and the radial covering, by means of a variation in the water passage section in the base of the assembly.

In addition, the system of attaching the rods in the base of the assembly (on a spike in the lower tip) makes it possible to support the rods both axially and in rotation.

1.2.2. Control and Systems

Control of the reactor (variation of reactivity caused by combustion and power variations) is handled entirely by 66 clusters of 18 absorbent rods of B4C enriched with boron 10. The elimination of the borication system (dilution is rendered useless because of the ineffectiveness of soluble boron) means that simplifications can be made in the following equipment:

a. RCV [Volume and Chemical Control];

b. REA [Water and Boron Addition];

c. RIS [Safety Injection];

d. TEP [Treatment of Primary Effluents];

e. REN [Nuclear Sampling];

f. Tubing layout.

The economic impact of the elimination of these features is of some significance.

The operation of such a reactor in which reactivity and power variations are handled by rods is made easy because of the excellent neutron stability of the core, and the decline in absolute value of these parameters:

a. excess reactivity due to depletion;

b. temperature and vacuum coefficient.

Based on the epithermal section, the effective section of absorption of boron 10 (in I/V) is smaller. This lowered effectiveness of boron requires the use of B4C absorbent rods enriched with boron 10. In addition, a second system of clusters (SAC), in order to maintain the subcritical level of the core, has been planned.

1.2.3. Primary Pump

The RSM core is more resistant hydraulically than the core of a PWR, because of the lowered moderation ratio. As a result, with the same pump characteristic, there is a decline in flow. Studies have shown that at the temperature of the primary

circuit of Paluel, despite the reduction in flow, there were still sufficient margins. This shows that the Paluel pump could be adequate.

### 1.3. Performances

A mean fissile fuel combustion rate of 64,000 MWJ/t U is possible through the use of steel sheathing. It makes the following performances possible:

| | Mean Combustion Rate of Core | Duration of a Program |
|---|---|---|
| Cycling by thirds | 21,300 MWJ/t U | 16 months |
| Cycling by fourths | 16,000 MWJ/t U | 12 months |

The power supplied by the various depleted uranium coverings represents on the average 15 percent of the total power.

The conversion rate for such a reactor is then 1.06, while the time required for doubling the plutonium--determined by taking into account the time of immobilization for cooling and reprocessing of the unloaded fuel (3 years)--is:

12.5 years for the RSMC; and

70 years for the RSME.

## II Strategic Interest

An estimate of the penetration of an RSM system has been done.

The following hypotheses were used for the example given as an illustration:

a. a supply of natural uranium of 300,000 tons, with a third of this consisting of French reserves, with the rest coming from new deposits or from imports;

b. a supply of 50 reactors of the Paluel 1300 type in 1990;

c. a 4 percent per annum increase in electricity consumption over the next few decades.

The conclusions of this estimate are as follows:

a. The "PWR alone" strategy will reach its limits toward 2010-2020 because of the depletion of reserves;

b. The "PWR + RSME" strategy will progress very slowly between 2005 and 2025 because of a shortage of plutonium, and will only really grow after 2030, but will not be able to catch up with the demand for electricity;

c. The "PWR + RSMC + RSME," which favors the accelerated production of plutonium, does follow the electricity demand.

III Economic Interest

The strategic interest of an undermoderated reactor can not be considered in isolation from economic contingencies.

For this reason, it seemed important to show that the cost per kWh produced by the RSM was placed correctly in relation to the cost per kWh produced by the PWR and the RNR.

The assumptions used for this comparison came from data provided by the PEON [Production of Electricity of Nuclear Origin] commission.

The cycle costs are comparable for the RSME to the costs of a PWR. For the RSMC, the results are somewhat more unfavorable, because of the need to enrich the uranium used.

In order to determine the total cost per kWh, we assumed that the amount of the investment and operating costs of the RSM were unchanged in relation to such costs for the PWR. This is a reasonable assumption, since the equipment is either similar or identical, and the same is true of the procedures used. So the cost per kWh is comparable to that of a PWR.

IV Sensitivity of Parameters

The preceding evaluations form only a preliminary study. For this reason, the results given are somewhat uncertain, which may change the interest shown in this type of reactor. A sensitivity study has been done in terms of both the strategic interest and the economic interest (cost price per kWh), by varying the principal characteristics of this reactor (RSM):

a. the conversion rate;

b. the mean line power;

c. the maximum possible mean combustion rate; and

d. the fluid intake temperature in the core.

The conversion rate comes from an optimization based on the neutron codes now available in France. A qualification of these codes has not been done on these types of systems. We should point out, though, that our results do agree quite well with those published by other authors, particularly those given in bibliographic reference 2 [not included], which were compared with a group of American experimental results.

The mean line power used (230 W/cm) is much lower than that of an RNR: 330 W/cm, but higher than the power cited by other writers.

The combustion rate used was selected in order to be lower than the rate now considered for the RNR. For this parameter, the RNR experience is directly applicable.

The risk related to the intake temperature is more difficult to evaluate, as the RNR experience is not applicable. It is to be determined in terms of the risk of corrosion of the sheaths and margin related to the DNBR [expansion unknown]. Concerning the risks of corrosion, some experience has been acquired with fuels sheathed in stainless steel in PWR and BWR [Boiling Water Reactor] systems. In particular, we can say that the stainless steel fuel sheath of the SENA series poses no more problems than a zircaloy fuel.

Then the following assumptions were made:

a. a reduction in line power (change to 205 W/cm);

a. a reduction in the conversion rate (change to 1.01);

c. a reduction in the combustion rate (change to 55,000 MWJ/t); and

d. a reduction in the intake temperature (change to 287°C).

The results do show the slight incidence of a variation of line power or the conversion rate on both the strategic and economic interest of this reactor.

In economic terms, the combustion rate is the most sensitive parameter. Fortunately, this is also the parameter for which the experience acquired with the RNR is most directly transposable, and based on the evolution of the knowledge acquired, the presently proposed value may be increased.

At the present time, the greatest uncertainty concerns the intake temperature. This may be brought into question again because of problems caused by the corrosion of fuel sheaths, much more than by problems related to the cooling of the fuel. However, a reduction in this temperature would not endanger the economic and strategic value of this reactor.

## V Conclusion

Like the authors listed in the bibliography [not included], we also found that the RSM may be of interest both in economic and strategic terms.

Further study and testing are necessary in order to confirm these preliminary evaluations.

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## NEW KIND OF NUCLEAR FUEL USES ZIRCALOY

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[Text] The decree authorizing COGEMA [Nuclear Materials Company] and FRAMATOME to build a nuclear fuel plant at the Pierrelatte site was published in early September.

This plant--known as the "Y" project--will manufacture fuels for pressurized water reactors. It is to begin service toward the end of 1983 or in early 1984. In the first phase its capacity will be 500 tons a year; this capacity may later be raised to 1,250 tons.

In order to carry out this project: construction and operation of the plant, design and development of the fuels, marketing of the products, COGEMA and FRAMATOME established two jointly-held subsidiaries: the CFC and FRAGEMA.

The plant will produce standard fuels and should relatively soon begin to produce a new, higher performance, more economical fuel element: the AFA [French Advanced Assembly].

The AFA is now being developed by FRAGEMA in cooperation with the CEA [Atomic Energy Commission] and the SICN (a COGEMA subsidiary).

Contrary to the standard fuel elements, whose structural material is Inconel, the AFA will use zircaloy, a material containing less cobalt, and which absorbs fewer neutrons. This will increase the efficiency of uranium usage, and will decrease the activity of the primary circuit.

Some other advantages of the AFA are that it is easier to machine and that it can be removed from both the top and from the bottom. In this way, if necessary it can be repaired during a scheduled reactor shutdown. This ease of removal will also help to facilitate the mechanical phases of reprocessing operations.

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BRIEFS

NUCLEAR PLANT FOR INDONESIA--Italy and Indonesia have signed, in Jakarta, an agreement relative to a loan of $3.75 million, obtained from Mediocredito Centrale, which uses the Banca Nazionale del Lavoro as agent bank, and intended for partial financing (25 percent) of the contract for the furnishing to Indonesia, by Nira, of the design, construction and startup of a laboratory for production of fuel of the heavy-water type, including conversion of fissionable material in the form of "yellow cake" into uranium-oxide powder of nuclear grade. The laboratory will be built at Serpong, 40 kilometers from Jakarta, as part of a large Interdisciplinary Research Center being built for Badan Tenaga Atom National (BATAN), for which a subsequent expansion phase has already been planned. An agreement with the ENEA [expansion unknown], which will furnish assistance to Nira for the particular process and safety aspects, is being finalized. The loan falls within the framework of the Ministry of Foreign Affairs' cooperation and development. The value of the contract is $15 million. [Text] [Rome NOTIZIARIO DELL'ENEA in Italian Mar 83 p 78] 11267

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